(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE

140 NASSAU STREET, NEW YORK

J. S. BONSALL,
Business Manager.

R. V. WRIGHT,
E. A. AVERILL, } Editors.

DECEMBER, 1908

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Contributions.—*Articles relating to Motive Power Department problems, including the design, construction, maintenance and operation of rolling stock, also of shops and roundhouses and their equipment are desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

A CHAT WITH THE EDITORS.

As the year draws to a close it may not be unprofitable to look backward and study the changes in policy and the improvements which have been made in our columns during the past year or two, with a view of forecasting the work of the year which lies before us. The splendid work which has been done by such men as Forney, Marshall and Basford has furnished a foundation and given this journal a standing which very few other publications in any field can have. With such an inspiration behind us it is little wonder that it has been possible to accomplish several things during the past year, or two, which have never before been attempted in technical journalism and which, it is believed, have effected far-reaching results.

This journal is the only one which devotes its entire energies to assisting the leading officers of the motive power, or mechanical, department in uplifting and bringing up the efficiency of that department. Besides keeping its readers fully informed as to the current progress in motive power department matters, including the design, maintenance and operation of locomotives, cars and other rolling stock, also of shops and roundhouses and the tools and appliances used in connection with them, special attention has been given to the larger problems, the proper solution of which will not only greatly increase the efficiency and effectiveness of the motive power department, but will eventually place it in the position in the general railroad organization which its importance deserves.

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There is no more important problem now before the motive power officers than that of organization and during the past two years this matter has received our most careful attention, finally culminating in the article on "Organization," which appears in this issue. There has been a great dearth of published information on this subject and, as a matter of fact, but few officers, either on railroads, or in industrial establishments, have grasped the subject in its entirety. Many instances may be cited of officers who have fully appreciated some of the fundamental principles, but we believe that the Lake Shore organization presents the best example of what may be considered an ideal and well balanced organization.

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An organization can never become strong unless it has some means for recruiting and raising the level of the men in the ranks. For many years railroad officials have realized that the prevailing apprentice systems were not at all adequate, but it remained for G. M. Basford to finally present a logical solution to the question. The ideas thus presented were promptly adopted by the New York Central Lines and as soon as these general principles were worked out in practice, and their success fully demonstrated, a complete study of all the details of the new system was presented in this journal, which occupies the unique position of being the only one in the railroad field which has systematically followed up the matter of rational apprenticeship, giving its readers the benefit of the best practice and most advanced thought on this subject.

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An organization to be most effective must be one in which the individual efficiency of every man in it has been brought to the highest possible point. The bonus system, which is used on the Santa Fe, might better be called an individual efficiency system. This work, which was started in the locomotive repair shops at Topeka, has gradually spread until it promises eventually to include every man in the motive power department. The only thorough and complete account of this work, ever published, appeared in this journal in December, 1906, and was really the first one of the larger problems of which a complete study has been presented in one issue of the journal, rather than the older method of scattering a large and important article over several issues. Our readers have been kept in touch with the expansion of the betterment work on the Santa Fe by at least a dozen other articles which have appeared, from time to time, during the past two years, and which were either gathered from the observations of the editors, or were prepared by the pioneers in this work, including such men as Harrington Emerson, H. W. Jacobs, Clive Hastings, C. J. Morrison, Raffe Emerson, J. F. Whiteford and J. E. Epler. A complete list of these articles will be found in a footnote on page 208 of the June, 1908, issue. They include articles on the bonus system, locomotive repair shop organization and operation, shop tools and equipment, standardization and manufacture of tools, the car department and roundhouse work.

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The rapidly increasing price of lumber, and the splendid service which has been given by steel freight cars, has caused the officers on many roads to consider the use of such equipment. The most serious objection to adopting it was the matter of its maintenance and repair and the fact that little was known as to the life of such cars. To meet the demand for such information, several weeks were given to a study of the question, resulting in the article on "Maintenance and Repair of Steel Cars on the Baltimore & Ohio," which appeared in the May, '07, issue of this journal. This is the only complete study of the question which has appeared, before or since that time, and has been followed up in this journal by a similar article describing the repair and maintenance of steel freight cars on the Pittsburgh & Lake Erie Railroad (January, 1908).

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The electrification of the New York Central, the New York, New Haven & Hartford and the Pennsylvania Railroads, in and about New York City, has hastened the advent of the steel passenger car. This journal has given greater attention to steel passenger car designs than any other publication and has been exceedingly fortunate in arranging with Messrs. Barba and Singer of the Pennsylvania Railroad, at Altoona, for a complete study of steel passenger car design, which has been running in serial form during the past year and will continue during the coming year, becoming even more interesting as it goes into the detail of the superstructure. These articles will close with a practical example, based on the theoretical analysis, as elaborated in the series.

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The drawing room has never been given the consideration which it should have, but during the past few years its importance has become more and more apparent and, as small roads have been formed into large systems, it has become necessary to entirely reorganize it. We were fortunate in securing G. I. Evans, chief draftsman of the Canadian Pacific, to prepare an article on the drawing room system in use on that road, which is one of the best on any road on this continent. This article, like all of those previously mentioned, was practically a pioneer in its field and is the only complete study of its kind which, as far as we have been able to find, has ever been published.

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Special attention has been given to the matter of new designs of machine tools, which have been brought out from time to time, and which are adapted to railroad shop work. Larger power, better equipped shops, better organization, the individual motor drive, and high speed steel have all combined to revolutionize the design of railroad shop machine tools and we have aimed to keep our readers fully informed as to the developments and progress in this field.

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The problem of the electrification of steam roads has been considered in such a way as to meet the demands of our readers. The matter of standardization of locomotives, cars and shop tools has been steadily agitated. No other publication has given so much attention to the design of locomotive and car details. As an instance, the matter of the Walschaert valve gear may be mentioned. This is the only publication which has shown the complete details of several of the more important applications of this gear.

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As an example of some of the new departures which have recently been added, the railroad club column deserves mention. This has met with the hearty approval of our readers, and it is the desire to handle it in such a way as to increase the interest in the work of these clubs.

Beginning with this issue a page each month will be devoted to data of special interest to the drafting room.

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Investigations, which have been made, indicate that a surprisingly large number of our readers have the journal bound, and that it is regarded by many as the standard reference book of the mechanical department. Because of this, special attention has been given to the annual index during the past two years, and we have tried to make the index for 1908 the most complete of any which have preceded it.

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This résumé of the work of the past two years will, we trust, give our readers a good idea of the policy and the spirit which will govern the editors in the work of the coming year. We wish to thank you for the hearty support which you have given us in the past and to wish you one and all a Merry Christmas and a Happy and Prosperous New Year.

FUEL ECONOMY.

The International Railway Fuel Association, which has recently been organized, as mentioned elsewhere in this issue, should receive the cordial and hearty support of railroad mechanical department officials. One hundred million tons of coal, or 25 per cent. of the total output, is used in railroad locomotives. Fuel for locomotives is the largest single item of expense in the cost of conducting transportation and this one item probably offers a greater opportunity for saving than is possible in any other branch of railroading. While the railroads have to some extent realized the importance of this question, yet their efforts in bringing about economies have been spasmodic and, generally speaking, have been directed toward some particular phase of the problem rather than toward handling it, as a whole, in a systematic manner. We were surprised, when making the study which resulted in the article on "Locomotive Fuel Economy," which appeared in the April issue, to see how little was being done to bring about greater efficiency and economy. The only way to get the best results is to follow the coal from its purchase, and its production in the mines, until it is consumed in the locomotive. The officers on many roads seem to be blissfully unaware of the possibilities in this direction, and there is no more promising field for a good lively association. We extend our best wishes for its success.

ORGANIZATION.

Undoubtedly many motive power officers, after reading the article on "Organization," will declare that they too have a general staff. As a matter of fact the greater number of the roads in this country have officers who would rightfully form part of such a staff, but the staff members are not giving nearly the returns they should simply because they are not properly organized and do not work together.

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Giving a railroad foreman, or officer, a vacation of at least two weeks, with pay, is a profitable investment for any railroad. It refreshes the man and brings him back to his work with renewed vigor, but far more important, it furnishes a splendid test to determine whether the organization under him is in good condition. As a fundamental principle, no officer or foreman should be eligible for promotion unless he has a man under him who can step up and take his place successfully; his absence from the work, on a vacation, will demonstrate whether he is living up to this requirement.

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Very few roads are making the most of their mechanical engineers' department. To make this department a success the mechanical engineer must be an executive officer and must be given a sufficient appropriation and backing to enable his office to anticipate the wants of the other branches of the department rather than to follow far in the rear, as is true in most cases. Too much emphasis cannot be laid upon the advantages of the system which is in use upon the Lake Shore.

THE RAILROAD CLUBS

Canadian Railway Club (Montreal).—Next meeting Tuesday, January 5. Prof. Bancroft will give a lecture on British Columbia.

At the meeting held December 1, E. P. Gutelius presented a paper on "Steel Rails."

The paper on freight car brakes, presented at the November meeting by W. V. Turner and S. W. Dudley, is probably the most complete study of this subject ever published. Some idea of its extensiveness may be gained from the fact that it requires 105 pages with two inserts and fifty illustrations. The paper opens with a discussion of the importance of the problem and is followed with a study of the development of freight car air brakes and a comparison of past and present conditions. This is followed by a description of the brake and its various features. A large number of charts, or diagrams, showing the results of different tests, are presented to illustrate the fundamental principles involved; to illustrate the rise and fall of brake pipe and brake cylinder pressures in long and short trains, both with the old and the new equipment; and to show the results of these improvements in actual service.

Secretary, Jas. Powell, P. O. Box 7, St. Lambert, near Montreal, Can.

Central Railway Club (Buffalo).—Next regular meeting, Friday, January 8.

At the November meeting George Wagstaff, formerly supervisor of boilers of the New York Central Lines and now with the American Locomotive Equipment Company, read a short paper on "The Relation of the Brick Arch to the Efficiency of the Present Day Locomotive Boiler." He spoke briefly of the history of the brick arch and of the development of locomotive boiler design. There is a great need for increased boiler capacity without adding materially to the present weights and advantage should be taken of every practical means looking toward this end. A general statement was made as to the advantages of the brick arch and attention was called to the Pennsylvania Railroad locomotive tests at St. Louis in which two consolidation engines with somewhat similar boilers were tested, one with a brick arch and the other without. The front end arrangement of these two boilers differed, but it was found that in the boiler with the brick arch a much smaller amount of cinders and sparks were drawn through the tubes and the temperature of the fire box was about 200 degrees higher.

Secretary, Harry D. Vought, 95 Liberty street, New York City.

New England Railroad Club (Boston).—Next meeting Tuesday, December 8. William F. Garcelon will speak on "The Railroad Man in Politics." The meeting will be held at the Copley Square Hotel—dinner at 6:30, meeting called to order at 8 P. M.

Secretary, George H. Frazier, 10 Oliver street, Boston, Mass.

New York Railroad Club.—The next meeting, December 18, will be the annual "Christmas Smoker."

At the November meeting, the result of the letter ballot for the election of officers was announced. The nominees, mentioned in our last issue, were all elected.

W. J. Harahan, in his paper on the elements which make a successful railway official, mentioned the following essentials: Honesty in its best sense—a studious and persistent effort to render just and fair treatment to all alike, whether great or small; loyalty; the gift of creating harmony which results in cooperation and teamwork; industry, or earnest, painstaking, patient and persevering effort to accomplish everything well and to do it cheerfully; thoroughness which in the end results in the saving of time and energy; love of work; common sense; originality; experience; ability to organize and systematize.

He mentioned the necessity of keeping in touch with conditions on the road; also of seeing that all instructions are properly prepared, are understood by those interested and lived up to. The successful officer must keep informed as to the progress made in his field by reading current technical literature and taking active part in technical associations and clubs. The employment, treatment and discipline of men requires the most careful consideration and study. The fundamental principles of business which are applicable to any successful industrial concern apply equally well to a railroad. Costs should be carefully studied and analyzed and if possible daily reports as to the previous day's business, including labor and material expenses, should be available. Last, but not least, the public should be treated with courtesy and frankness.

Secretary, Harry D. Vought, 95 Liberty street, New York City.

Northern Railway Club (Duluth, Minn.).—Next meeting December 26. Wayne A. Clark, chief engineer of the D. & I. R. R. R., will present a paper on "Concrete and Steel Ore Docks."

Instead of having the two papers, mentioned in our last issue, for the November meeting, the annual meeting, including a banquet and dance, was held at Superior. The papers by Messrs White and Richards are now scheduled for the January meeting.

Railway Club of Pittsburgh.—Next meeting Friday evening, December 18.

At the annual meeting in October the following officers were elected: D. J. Redding, master mechanic, P. & L. E. R. R., president; F. R. McFeatters, superintendent, Union R. R. Co., first vice-president; Wm. Elmer, Jr., master mechanic, Pennsylvania R. R., second vice-president; C. W. Alleman, P. & L. E. R. R., secretary; J. D. McIlwain, Main Belting Co., treasurer.

At the November meeting N. K. Hoffman, superintendent of car service, P. & L. E. R. R., read a paper on "Transportation." It was largely of a historical nature, but with some detail as to the methods of shipping and billing freight over different rail roads, and a prophecy as to the future of water transportation and its effect upon rail transportation.

Secretary, C. W. Alleman, P. & L. E. R. R., Pittsburgh, Pa.

Richmond Railroad Club.—Next meeting Monday, December 14.

Alex Kearney's paper on "Locomotive Flues—Endurance of Materials," read at the October meeting, is a most interesting and valuable contribution on this subject. Although the different parts of locomotive boilers have been strengthened and redesigned to meet the more severe demands and service of recent years, practically no change has been made in the flue and its method of application, except that it has been lengthened. The effects of excessive rolling were illustrated by photographs. Attention was directed to the guttering of the flue sheet due to use of the beading tool. Experiments are now being made to see if the beading cannot be done away with by using the reinforced flue sheet, as shown on page 206 of the June issue of this journal.

The major portion of Mr. Kearney's paper was given over to a consideration of the proper material for flues. Some interesting experiments were cited to show that the beads at the firebox end of the flue absorb a certain amount of sulphur and this apparently shortens the life of the flue. Apparently the hot flues absorb a certain amount of the gases which pass through them and the exact effect of this upon the endurance of the material should be determined and be taken into consideration by manufacturers of flues.

Secretary, F. O. Robinson, 8th and Main streets, Richmond, Va.

St. Louis Railway Club.—Next meeting Friday, December 11. Samuel D. Webster, freight claim agent of the Terminal Railroad Association of St. Louis, will present a paper on "The Adjustment of Claims for Loss and Damage of Freight." This is also the "Annual Christmas Smoker"; the meeting will be held in the large dining room of the Southern Hotel.

At the October meeting W. G. Besler, vice-president and general manager of the Central Railroad of N. J., and the second president of the St. Louis Railroad Club, spoke briefly of the opportunities open to the poor boy; he commented at length upon the fact that legislation has come to be considered the grand panacea to be invoked to cure "all the ills that flesh is heir to" and stated that the threatening evil of the present time is abnormal regulation. He showed that there are cerain natural laws governing the railroads which are far more effective than any artificial ones which may be made.

At the November meeting John J. Baulch, president of the club, presented a paper entitled "Are Railroad Clubs Worth While?"

Secretary, B. W. Frauenthal, Union Station, St. Louis, Mo.

Western Railway Club (Chicago).—Next meeting Tuesday, December 15. J. J. Hennessey, master car builder of the Chicago, Milwaukee & St. Paul Ry., will read a paper on "The Abuse of the Repair Card."

At the November meeting Prof. Chas. H. Benjamin, dean of the School of Engineering and director of the engineering laboratory, Purdue University, Lafayette, Ind., presented a paper on "Flat Spots on Car Wheels." In analyzing the problem, the formula for the energy of impact of a flat wheel, developed by Prof. E. L. Hancock of Purdue University (see AMERICAN ENGINEER, May, 1908, page 188) was used. Prof. Benjamin also described a testing machine with which experiments could be made and from the results of these a working formula could be developed for practical use. In the discussion the proof sheets of a paper, which H. H. Vaughan had prepared for the December issue of the AMERICAN ENGINEER, were read (see page 475), in which it was shown that Prof. Hancock's formula is incorrect, not being based on the proper assumptions.

Geo. A. Post, president of the Railway Business Association, addressed the club on "Railroads and the Business Revival."

Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

EFFECT OF FLAT WHEELS ON RAILS.

H. H. VAUGHAN.

In the May number of THE AMERICAN ENGINEER, page 188, an article appeared by Mr. E. L. Hancock, discussing the effect of a flat wheel on a rail in which it was calculated that the blow delivered by the wheel was exceedingly serious in its amount and increased very considerably with the speed. This calculation was based on two assumptions, namely, that the weight carried by the wheel could be considered as a weight concentrated at the center of the axle, and that the leading edge of the flat spot remained in contact with the rail, while this weight described a circle around it. Neither of these assumptions is justifiable. In the first place, allowing that the wheels, together with such other parts of a car or tender as are carried below the springs, may be considered as concentrated at the axle, the body of the car is spring supported and cannot be considered as acting in the manner assumed, and in the second place the edge of a flat spot on a wheel with any given weight concentrated at its center would not remain in contact with the rail after a certain critical speed is reached.

A more reasonable method of considering this problem is to assume that the weight supported by each wheel below the springs is concentrated at the center of the axle and that this weight is pressed down by a force equal to the weight supported by each wheel above the springs and these quantities may be roughly taken at 1,600 lbs. and 14,400 lbs., respectively, giving a total weight per wheel of 16,000 lbs., or of 128,000 lbs. per car.

On this basis the problem has been thoroughly worked out by Mr. L. S. Spilsbury, of the office of the Engineer of Bridges, Canadian Pacific Railway, whose mathematical discussion is given below.

The results of this thorough and ingenious analysis are entirely different from those previously obtained and may be summarized as follows:

The striking velocity of the trailing edge of the flat spot on the rail increases proportionately to the speed up to a critical speed at which the leading edge leaves the rail. This critical speed under the assumption as to weights, etc., specified above, is about 21 feet per second, or 14.5 miles per hour for a 33-inch wheel.

After this critical speed is reached, there is a small range of higher speeds during which the leading edge of the flat spot after leaving the rail hits it again almost instantly, then one slightly higher speed at which the flat surface strikes the rail, after which the leading edge of the flat spot, after leaving the rail, does not again touch it, and the wheel leaves the rail until the trailing edge of the flat spot strikes it; this last condition continues indefinitely as the speed increases.

After this last condition is reached the velocity with which the trailing edge of the flat spot strikes the rail is constant. It varies, for small flats, directly as the length of the flat, directly as the square root of the ratio between the total weight supported by the wheel to the weight below the springs and inversely as the square root of the radius of the wheel. For a 33-inch wheel supporting a total weight equal to ten times the weight below the springs, this constant and maximum striking velocity is as follows:

For 3 " flat spot	....	3.8 feet per second.
For 4½" flat spot	....	5.7 feet per second.
For 6 " flat spot	....	7.6 feet per second.

The blow delivered by the wheel at these velocities corresponds to that delivered by a weight of 1,600 pounds falling through the following distances:

For 3" flat spot	....	0.22 feet.
For 4½" flat spot	....	0.50 feet.
For 6" flat spot	....	0.89 feet.

The results of these calculations are in close accordance with practical experience, and the curious fact that the blow delivered by a flat spot is constant after a certain speed is reached corresponds with the sound given at varying speeds.

The blow delivered on a rail by a flat spot while severe is not to be compared with that of a 2,000-pound weight falling through several feet, and is well within the capacity of any sound rail to withstand.

The regulations of the Master Car Builders' Association give ample protection against excessive blows and do not allow wheels to run in a condition that may prove injurious to the rail.

Mr. L. S. Spilsbury's calculations are as follows:

Let R = radius of wheel in feet.
l = length of flat spot in feet.
d = depth of flat spot in feet.
V = velocity of center of wheel parallel to rail in f. s.
w = angular velocity of wheel $= \frac{V}{R}$
P = pressure of spring on wheel when motion is steady, in lbs. (This is assumed constant throughout.)
W = weight of wheel in lbs.

Then $(2R - d)\, d = \frac{l^2}{4}$ (See Fig. 1.)

$$a = \frac{\pi}{2} - 2\Phi = \frac{\pi}{2} - 2 \sin^{-1} \frac{1}{2R}$$

When the wheel is in position shown in Fig. 1 it is instantaneously turning about O, and the resultant upward acceleration $= \frac{V^2}{R}$ f. s. per sec.

It also has a downward acceleration due to the spring

$$= \frac{P + W}{W} g = f.$$

So the point O will rise off the rail as soon as $\frac{V^2}{R} > f$

i. e., when $V > \sqrt{fR}$.

So the limiting speed, $V_{Lt} = \sqrt{fR}$ f. s.

I. Before the limiting velocity is reached.

V_s = striking velocity of pt P $= \frac{V}{R} l$.

So for any given wheel and flat spot, V_s will increase

C C_1 C_2 is path of centre of wheel from when C O is vertical until C P is vertical

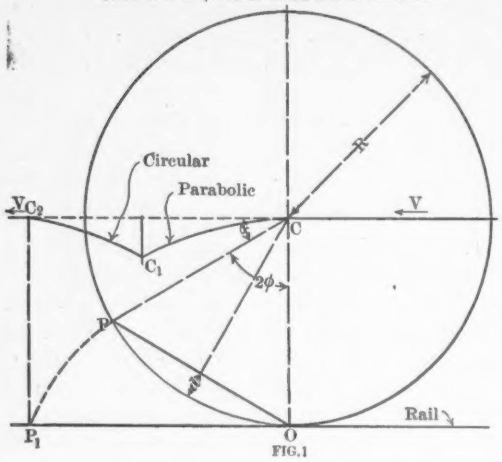


FIG.1

uniformly until the limiting vel. is reached, when

$$V_s = V_{Lt} \times \frac{l}{R} = l\sqrt{\frac{f}{R}}$$

II. After the limiting velocity is reached.

Let t secs. = time taken from when O leaves the rail to when P strikes the rail.

Downward accel. of wheel $= f = \frac{P + W}{W} g$ f. s. per sec.

The motion of point P (see Fig. 2) is made up of two distinct motions:

(a) Translation. That of the wheel as a whole which moves Vt. ft. horz. forward and ½ ft.² ft. vert. down.

(b) Rotation of wheel about its center through angle wt, during which P moves from P_0 down to the rail at P_1.

We have $P_0 P_1 = 2 R \sin \frac{wt}{2}$

$$\gamma = a + \frac{wt}{2}$$

$$P_0 N_1 = P_0 P_1 \cos \gamma = 2 R \sin \frac{wt}{2} \cos \left(a + \frac{wt}{2}\right)$$

$$P_1 N_1 = P_0 P_1 \sin \gamma = 2 R \sin \frac{wt}{2} \sin \left(a + \frac{wt}{2}\right)$$

Now $L_1 M + M P_0 + P_0 N_1 = CO = R$

$$\therefore \tfrac{1}{2} ft^2 + R \sin a + 2 R \sin \frac{wt}{2} \cos \left(a + \frac{wt}{2}\right) = R,$$

or $\frac{1}{2} ft^2 + R \sin (a + wt) = R$ ....(A)

Distance between points of departure and strike:

$= OP_1$

$= ON + NP_1$

$= Vt + R \cos (a + wt)$

At the instant of striking, vertical velocity of the wheel as a whole = ft downwards.

The velocity of P_1 due to rotation is V perpendicular to $C_1 P_1$. Its vertical component $= V \cos (a + wt)$.

$\therefore V_s = ft + V \cos (a + wt)$ ....(B)

From (B) we get:

$V_s = ft + Rw \cos (a + wt)$

$= ft + Rw \sin \left(\frac{\pi}{2} - a - wt\right)$

$= ft + Rw \left(\frac{\pi}{2} - a - wt\right)$, since $\left(\frac{\pi}{2} - a - wt\right)$ is very small

$= t (f - Rw^2) + Rw \left(\frac{\pi}{2} - a\right)$...............(C)

From (A) we get:

$$\tfrac{1}{2} ft^2 + R \cos \left(\frac{\pi}{2} - a - wt\right) = R$$

or $\frac{1}{2} ft^2 + R\left[1 - \frac{\left(\frac{\pi}{2} - a - wt\right)^2}{2}\right] = R$, since $\left(\frac{\pi}{2} - a - wt\right)$ is small.

or $t\left(w + \sqrt{\frac{f}{R}}\right) = \frac{\pi}{2} - a$

Substituting in (C) for t, we get:

$$V_s = \left(\frac{\pi}{2} - a\right)\left[\frac{f - Rw^2}{w + \sqrt{\frac{f}{R}}} + Rw\right]$$

$$= \left(\frac{\pi}{2} - a\right)\left[\frac{f + Rw\sqrt{\frac{f}{R}}}{w + \sqrt{\frac{f}{R}}}\right]$$

$$= 2 \sin^{-1}\left(\frac{l}{2R}\right) \times \sqrt{fR}$$

For small flats, $\sin^{-1} \frac{l}{2R} = \frac{l}{2R}$

$\therefore V_s = 2 \frac{l}{2R} \times \sqrt{fR} = l\sqrt{\frac{f}{R}}$ ....(D)

After the limiting velocity is reached.

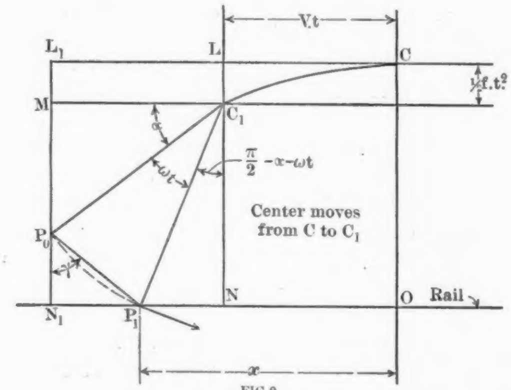


FIG.2

THE ANGLE INDICATED BY THE GREEK LETTER ALPHA IN THIS DIAGRAM IS DESIGNATED BY THE LETTER a IN THE FORMULÆ.

This shows that after the limiting velocity is reached, the striking velocity becomes independent of the wheel's velocity, and is constant for any given wheel and flat spot:

For any given wheel, V_s varies directly with the length of flat spot.

The general result is therefore:

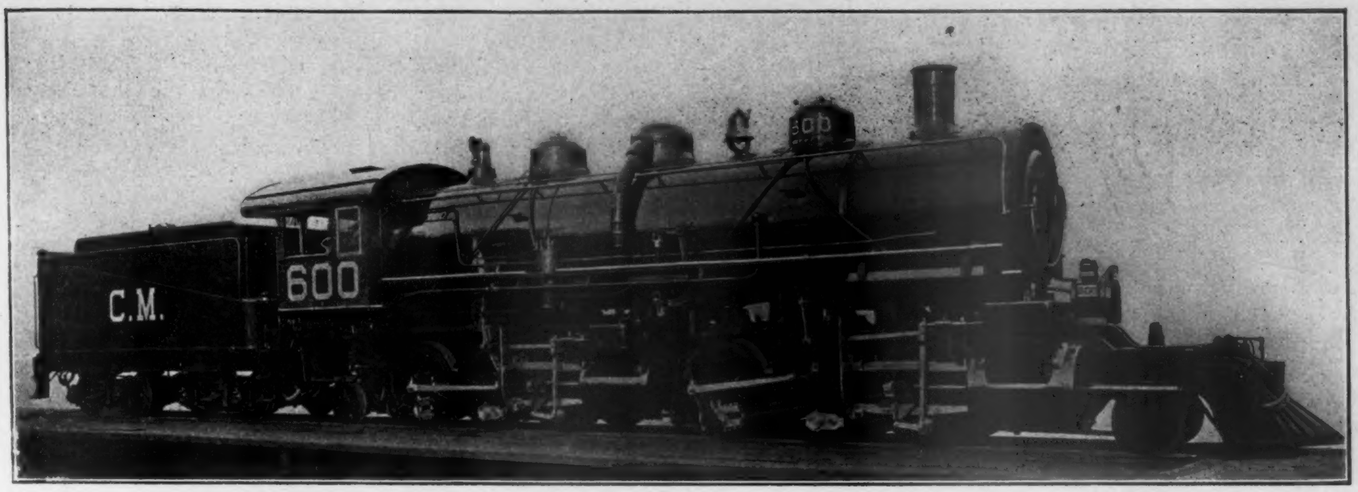
Before limiting velocity is reached

$V_s = \frac{V}{R} l$, increasing uniformly from o to $l\sqrt{\frac{f}{R}}$

After limiting velocity is reached

$$V_s = l\sqrt{\frac{f}{R}}$$

CONCRETE ROAD FOR AUTOMOBILES.—The Long Island Motor Parkway, which will eventually have a length of some 60 miles at about the axis of the length of Long Island, is a high speed automobile road with a reinforced concrete pavement. At present about nine miles have been finished. The Parkway is entirely on a private right of way, fenced in, and has no grade crossings. The concrete pavement is 22 ft. wide and over 6 in. thick and is reinforced with wire mesh placed near the bottom. The surface is left rough and sufficient lamp black is used in the mixture to give a pleasing light gray color. The roadway is intended entirely for automobiles and the curves are banked for a speed of 60 miles per hour. All curves and grades are very easy. A toll will be collected for the use of this road.



MALLET ARTICULATED COMPOUND LOCOMOTIVE FOR ROAD SERVICE—MEXICAN CENTRAL RAILWAY.

MALLET ARTICULATED COMPOUND LOCOMOTIVE

MEXICAN CENTRAL RAILWAY.

The Baldwin Locomotive Works has recently completed a very large articulated compound locomotive for regular freight service on the Tamasopo Division of the Mexican Central Railway. This division has frequent curves of from 15 to 22 degrees, maximum grades of 3 per cent. and is laid with 85-lb. rails.

The locomotive is of the 2-6-6-2 type and is very similar in every way to the five locomotives built by this company about two years ago for pushing service on the Great Northern Railway. These engines were illustrated on page 371 of the October, 1906, issue of this journal. The Mexican Central engines are somewhat lighter, weighing but 338,000 lbs. total and 300,000 lbs. on drivers (both estimated weights), as compared with 355,000 and 316,000 lbs. for the Great Northern engines. This difference in weight is probably largely accounted for in the difference in size of the two boilers, the Mexican Central engine having a straight top boiler, 70 in. in diameter, while the Great Northern engine was of the Belpaire type 84 in. in diameter at the front ring. There is a difference of over 20 per cent. in the amount of heating service in the two cases, made up practically altogether by the difference in the number of tubes, as the length is the same in both cases; the Great Northern engines having 441-2-¼ in. tubes, while the Mexican Central engine has but 350 tubes of the same size. Since oil is to be burned in the latter the grate is made narrower and longer but gives the same ratio to heating surface as is found in the larger boiler. In other respects the Mexican Central engines, although they are intended for regular road service, differ from the pushers only in the details which have been improved in view of the experience gained from the operation of the earlier design. McCarroll air reversing gear is used; the trailing truck is equipped with a special arrangement of side bearings and the reversing gear has the universal joint to prevent disturbance of the valve gear on the front engines when curving, all of which features were incorporated in the former design.

The tender is arranged for a capacity of 8,000 gallons of water and 3,500 gallons of fuel oil, the oil tanks being above the water tanks, both being wedge shaped.

The headlight will be seen to have been located in an unusual position and much nearer the rails than has before been considered necessary or desirable, even for slow speed freight locomotives.

The general dimensions, weights and ratios are as follows:

GENERAL DATA.	
Gauge	4 ft. 8½ in.
Service	Freight
Fuel	Oil
Tractive effort	71,600 lbs.
Weight in working order, estimated	338,000 lbs.
Weight on drivers, estimated	300,000 lbs.
Weight on leading truck, estimated	19,000 lbs.
Weight on trailing truck, estimated	19,000 lbs.
Weight of engine and tender in working order, est.	495,000 lbs.
Wheel base, driving	9 ft. 2 in.
Wheel base, total	44 ft. 2 in.
Wheel base, engine and tender	70 ft. 11 in.
RATIOS.	
Weight on drivers ÷ tractive effort	4.20
Total weight ÷ tractive effort	4.70
Tractive effort × diam. drivers ÷ heating surface	873.00
Total heating surface ÷ grate area	74.00
Firebox heating surface ÷ total heating surface, per cent	4.45
Weight on drivers ÷ total heating surface	66.50
Total weight ÷ total heating surface	74.50
Volume equiv. simple cylinders, cu. ft.	20.75
Total heating surface ÷ vol. cylinders	217.00
Grate area ÷ vol. cylinders	2.93
CYLINDERS.	
Kind	Mallet Comp.
Diameter and stroke	21½ & 33 x 32 in.
Kind of valves	Bal. Slide
WHEELS.	
Driving, diameter over tires	55 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	10½ x 12 in.
Driving journals, others, diameter and length	10 x 12 in.
Engine truck wheels, diameter	28½ in.
Engine truck, journals	6 x 12 in.
Trailing truck wheels, diameter	28½ in.
Trailing truck, journals	6 x 12 in.
BOILER.	
Style	Straight
Working pressure	200 lbs.
Outside diameter of first ring	78 in.
Firebox, length and width	123½ x 71 in.
Firebox plates, thickness	3/8 & 9/16 in.
Firebox, water space	5 in.
Tubes, number and outside diameter	350—2¼ in.
Tubes, length	21 ft.
Heating surface, tubes	4311 sq. ft.
Heating surface, firebox	201 sq. ft.
Heating surface, total	4512 sq. ft.
Grate area	61 sq. ft.
TENDER.	
Frame	12 in. chan.
Wheels, diameter	33 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	8000 gals.
Oil capacity	3500 gals.

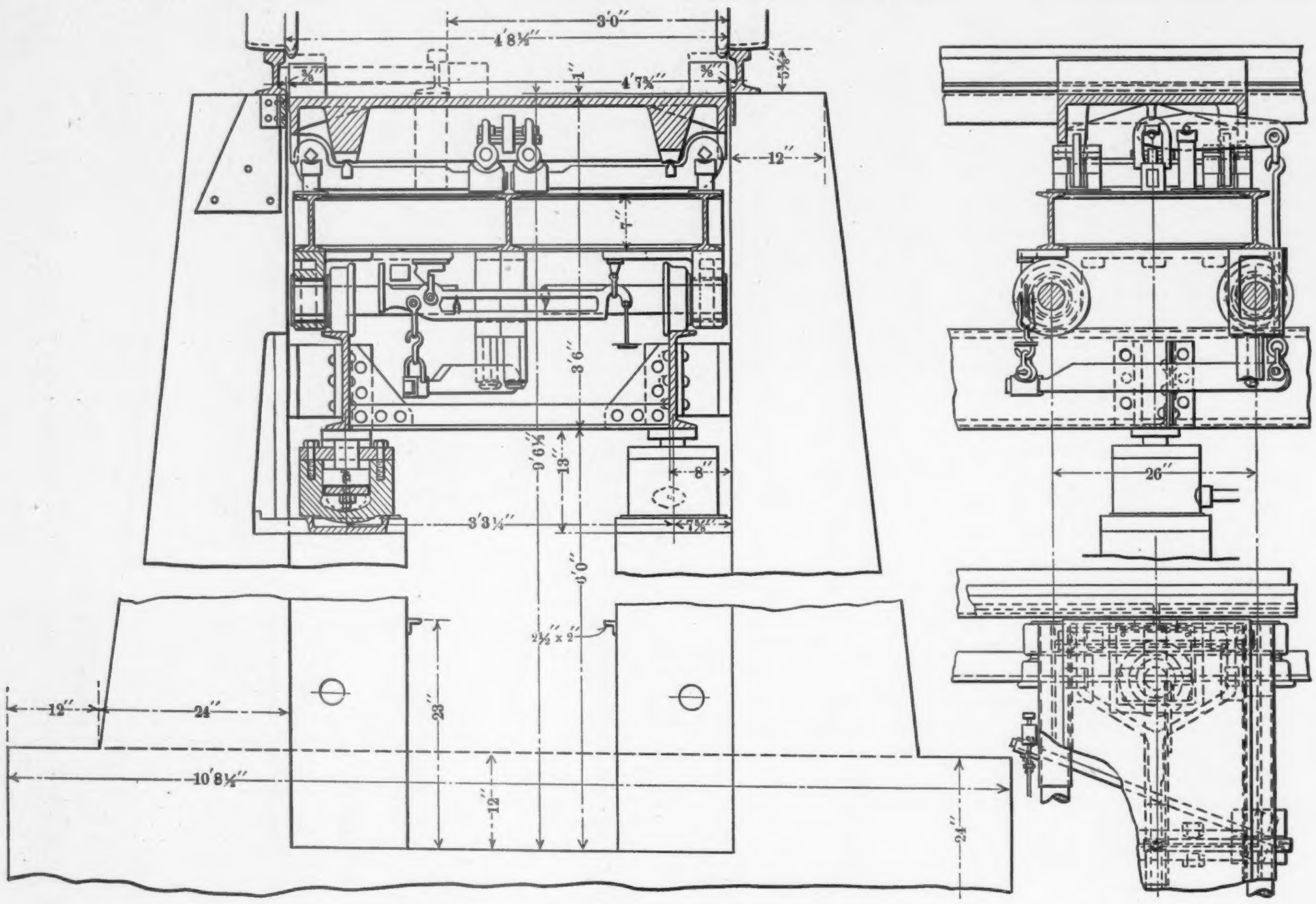
SUPPLY OF CRUDE RUBBER.—Many people are asking whether or not the supply of crude rubber will soon be exhausted. I might say that the supply is practically inexhaustible. In Brazil there are thousands of miles not yet opened up; the same thing applies to Africa and other sources. Then, again, Ceylon and the Straits Settlements are planting trees by the million. The reason rubber has advanced so rapidly in price is because of the increased demand.—*A. D. Thornton, general technical superintendent, Canadian Rubber Company, before the Canadian Railway Club.*

DEVELOP YOUR SUBORDINATES.—He should surround himself with the most capable men he can find for the respective positions under him. Some men, by their actions, seem to feel that brilliant subordinates may detract from them. There can be no more mistaken idea, nor can there be a more short-sighted policy. A man of moderate capacity, can, in a relatively high position, be successful with good and capable subordinates—but a brilliant man cannot be successful with incompetent subordinates because of the very physical impossibility of one individual knowing the details of a large business.—*W. J. Harahan, before the New York Railroad Club.*

A LOCOMOTIVE SCALE.

The American Locomotive Company has recently installed a locomotive scale, at its Schenectady works, with which the weight on each pair of wheels may be accurately obtained for any locomotive, from the smallest narrow gauge to the big Erie Mallet compound with eight pairs of drivers. If a locomotive should be built with a greater number of wheels, additional scale units may be added.

The old method of weighing the locomotive on an ordinary scale, obtaining the weight of different combinations of wheels and from these determining the weight on each pair, is not very satisfactory or accurate, even if the scale is in first-class condition. The scale at Schenectady is radically different from any which has thus far been built; it is placed on a substantial foundation, is installed in a special building to which only those in charge of the weighing have access, and is so designed that it is not subjected to any jars or shocks from locomotives or cars running over it.



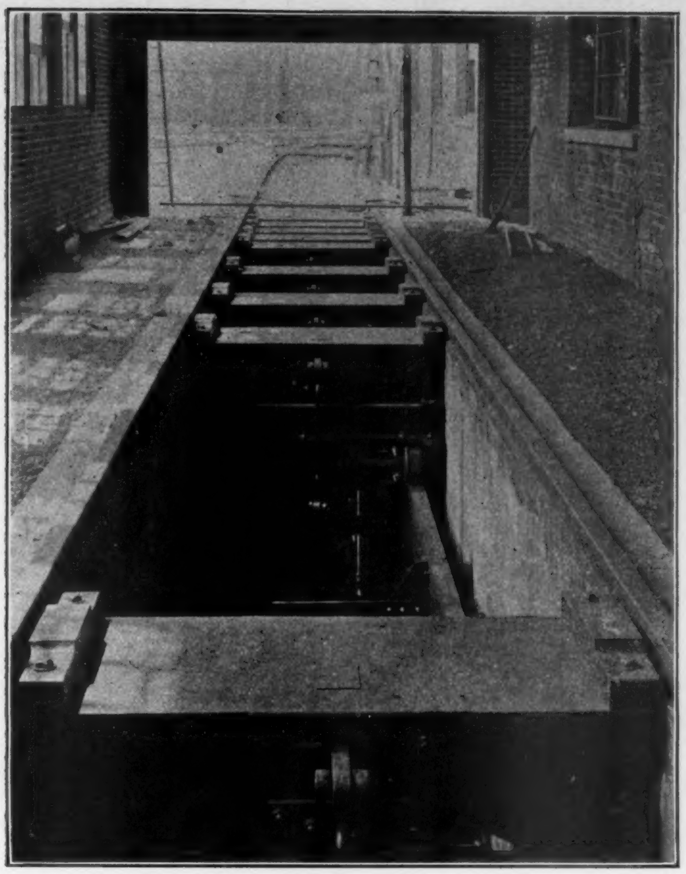
LOCOMOTIVE SCALE—AMERICAN LOCOMOTIVE COMPANY.

There are several advantages in having such a scale. It affords a close check on the designers and estimators. Foreign roads are very particular about having the weights agree closely with the specifications and insist on having the actual weight on each pair of drivers checked accurately. Roads which wish to build engines of as large size and capacity as the roadbed will admit may be assured that the weight on any pair of drivers does not exceed the desired limit.

As may be seen from the illustrations, the scale consists of several (eight) 35-ton scales, each carried on a truck. The locomotive is run over the pit on the permanent track and a scale is placed centrally under each pair of wheels. Oil is forced into the small cylinders and the piston rods, on which the platform is supported, and the scale trucks are slowly and evenly raised upward, lifting the locomotive clear of the track. As the oil cylinders have been accurately leveled and the travel of each piston is exactly the same the distribution of the weight is not in any way disarranged.

Foundation.—The foundation is of concrete; it is 6 ft. 8½ in. wide and 53 ft. 4 in. long at the top, and 10 ft. 8½ in. wide and 55 ft. 4 in. long at the bottom. It is reinforced throughout with scrap rods. The scale platforms, when they rise, come in contact with the wheel flanges and for this reason the inner flanges of the rails have been planed off. To assist in supporting the rail and to keep the concrete from being broken away at the corners a plate 6 in. wide and ½ in. thick has been placed along the edge. At intervals of three feet, ½ in. anchor plates have been placed in the concrete; the side plate is attached to these by means of 3 x 3 x ½ in. angles. The rail is fastened to the foundation by anchor bolts spaced at proper intervals. The columns upon which the hydraulic cylinders rest are 14 x 15 in. in section, are an integral part of the foundation and reinforced and tied to it by ¼ x 2 in. straps set in the concrete. They are spaced 5 ft. apart.

Hydraulic Cylinders and Platform.—The cylinder castings set into heavy castings which not only form caps for the pillars, but are let into the side of the main foundation as shown. The cylinders have 6 in. pistons which, with 1,200 lbs. pressure per square inch, will lift 33,600 lbs. The total lift of the twenty-two cylinders is thus 739,200 lbs. The pistons are fitted with leather packing rings, as shown. The hydraulic pressure is furnished by an 1,800 lb. pressure pump driven by a belt from a shaft extending through from the wheel shop. The piping is 1 in. D. E. S. Where it is necessary for it to pass through the concrete walls, or pillars, 4 in. galvanized iron pipe has been laid in the concrete. It is the practice, after the pistons have been forced upward to the limit of their travel, to shut off the pump in order to eliminate any vibration due to its impulses. Under the high pressure used there is a slight leakage at the piston packing and unless the weighing operations are conducted very quickly the pump has to be cut in again in order to keep the locomotive clear



LOCOMOTIVE SCALE.

of the permanent track. A simple pressure intensifier will shortly be installed, thus overcoming this difficulty. The platform, which rests upon the cylinders, consists of two 12 in., 40 lb. channels tied together by 12 in. channels at the ends and by 3 x 3 x ½ in. angles, as shown. There are angle plates at each of the cross braces which act as guides, coming in contact with the castings imbedded in the sides of the foundation.

Scale Trucks and Scales.—The wheels of the scale trucks run on the top of the 12 in. channels. The truck journals are equipped with ¾ in. cold rolled steel rollers, a steel bushing being forced into the bearing casting. The wheels are 8 in. and the journals 3½ in. in diameter. The truck side frame members are of cast iron and carry the 7 in. I-beams which support the scale mechanism. The platform of the scale is of cast steel, carefully ribbed to support different gauge locomotives. Because of the limitations in the width and length of the scale it was necessary to make it of very compact design. The supports for the main pivots at the corners are of cast steel. The distance of the bearing pivot from the main pivot is only 4½ in. and the end pivot is only 22½ in. from the main pivot. The main lever is of cast iron. The line drawings show clearly how the weights are transmitted to the scale beams.

The men who adjust the scale trucks and take the weights descend into the pit and by standing on the 2 x 2½ in. angles, running lengthwise and attached to the pillars, can perform their duties without inconvenience.

Weighing Narrow Gauge Locomotives.—To weigh narrow gauge locomotives arrangements have been made to place a temporary rail over the pit, supported by struts as shown by the dotted lines on the cross sectional view. A cast iron block will be placed on the scale platform alongside the track, as shown.

The general features of the scale were designed by the engineering department of the American Locomotive Company and the scales were designed and built by the Buffalo Scale Company.

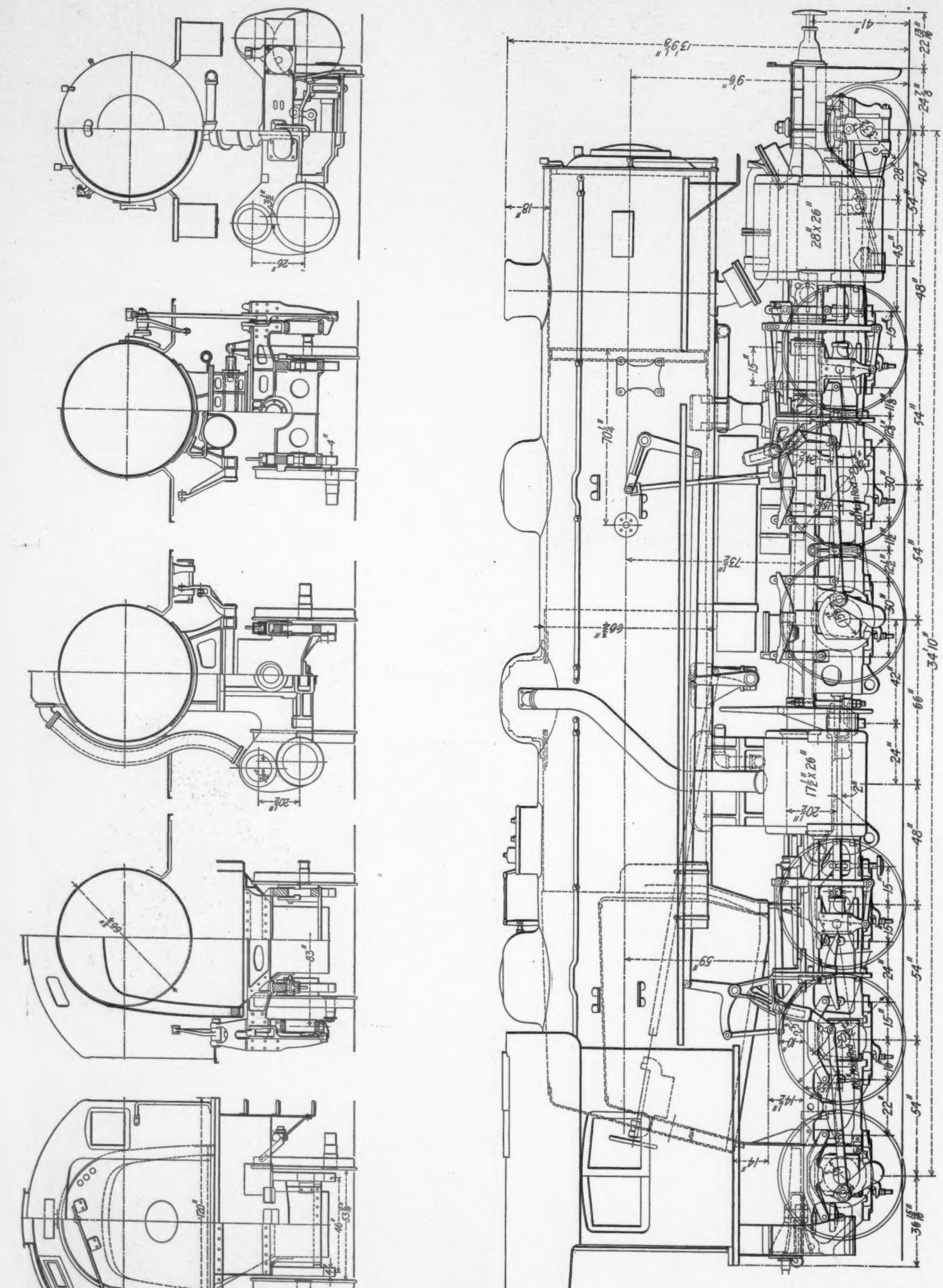
The new Pennsylvania station in New York City will have 1,000,000 sq. ft. of solid masonry floors.

BEQUESTS TO THE M. C. B. & M. M. ASSOCIATIONS

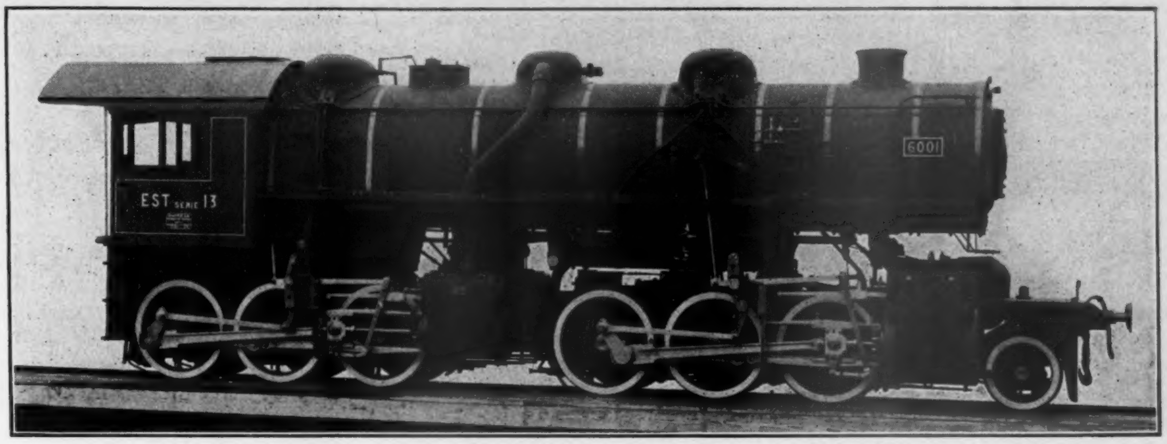
There was probated on September 29 the will of Mrs. Luther G. Tillotson, containing bequests of $5,000 each to several associations, among them the American Railway Master Mechanics' Association and the Master Car Builders' Association. Mrs. Tillotson's bequest, undoubtedly made at the request of L. G. Tillotson, who died in 1885, recalls the memory of a fine type of railroad supply man. Tillotson's father was a pioneer builder of telegraph lines and the son became a telegraph operator in the service of the Erie Railroad. His name was known, and well-known, for many years and associated with that of General E. S. Greeley as dealers in railroad and electrical supplies on Dey street, New York.

THE BRICK ARCH.—In view of the recent great improvement in boiler care and maintenance, in addition to the successful treatment of water, and the successful improvements in hot water boiler washing plants, etc., the disadvantages claimed for the brick arch have almost been practically overcome. From the earliest history of the arch there does not seem to have been any question about its advantages and its value in locomotive operation, and therefore, with the wiping out of the disadvantages, the non-use of the brick arch means the practical throwing away of a large amount of valuable power. The arch is recognized as the most efficient device for reducing the quantity of sparks thrown from the stack, and, on this account, it becomes directly valuable as a fuel saver. It increases the length of the flame, and the finer fuel, when lifted from the grate, is baffled by the arch, and is consumed, instead of passing directly to the tubes and out of the stack in the form of sparks. It causes more equal distribution of the draft over the grate and thus improves the furnace action. Its function in the firebox being that of a mixer and baffle, brings about a more complete mingling of the gases, and thereby aids combustion, resulting in a higher temperature, and the production of a smaller proportion of carbonic oxide.—*George Wagstaff, before the Central Railway Club.*

ONE OF THE SCALE TRUCKS.



MALLET ARTICULATED COMPOUND FREIGHT LOCOMOTIVE FOR ROAD SERVICE—EASTERN RAILWAY OF FRANCE.



MALLET ARTICULATED COMPOUND LOCOMOTIVE

EASTERN RAILWAY OF FRANCE.

The American Locomotive Company has recently completed, at its Schenectady works, two Mallet compound locomotives of the 2-6-6-0 type for the Eastern Railway of France. These engines are intended for road service and will handle freight on a mining division of the road, where they replace four cylinder compound consolidation locomotives.

These locomotives are of special interest in several ways, one of which is the fact that with the exception of the threads on bolts and nuts, the tires, staybolts and boiler tubes, all parts of the engine are built to English measurement and the general design is decidedly American throughout.

The application of the front engine truck, which was specified by the railroad, compelled the designer to introduce features which have not heretofore been used on this type of locomotive in this country. With the exception of the front truck and the changes hinging on its use, this design is very similar in all respects to the engines built by the same company for the Central Railway of Brazil (see AMERICAN ENGINEER, December, 1907, page 485).

The application of truck wheels to locomotives of this type is a question that is receiving considerable discussion and is to be very fully treated by a paper before the American Society of Mechanical Engineers at the annual meeting of this year. In the present case their application compelled the location of the boiler considerably farther forward on the running gear than has been usual, in order to obtain a satisfactory distribution of weights. This places the high pressure cylinders but a short distance in front of the fire box and locates the low pressure cylinders in such a position as to make it necessary to extend the exhaust pipe to the forward side of the casting, in order to obtain sufficient length to prevent cramping on curves. Although the steam passages have been made liberal and the turns given as large a radius as possible, this presents a very tortuous passage for the exhaust steam, which, while objectionable, was unavoidable in this case.

It will be noted that there is but one boiler support on the front group of wheels, whereas previous designs have two or more, although but one is supposed to act under normal conditions. In the present case this arrangement was necessary in order to obtain the proper distribution of weights. It contains a spring centering device in the usual manner.

Another alteration has been made in this engine in connection with the intercepting valve, which has taken the ordinary form of the Richmond compound intercepting valve, in which the emergency exhaust valve is contained in the same chamber as the intercepting valve instead of being a separate mechanism on the outside of the cylinder casting.

The boiler follows standard American practice, with the exception of the use of a copper inside fire box, copper stays and the metric tubes. Its dimensions, heating surface, etc., are given in the table below. The throttle is of the steam separator design, which was used on the Erie locomotives (AMERICAN ENGINEER, September, 1907, page 340).

As illustrating the advantages of the Mallet type locomotives for regular road service in connection with the reduction of weights of the moving and wearing parts the following comparison with a heavy consolidation on the New York Central Lines is interesting:

	Mallet.	Consolidated.
Total weight	206,000 lbs.	234,000 lbs.
Weight on drivers	182,000 lbs.	208,700 lbs.
Tractive effort	42,300 lbs.	45,700 lbs.
Diameter of driving wheels	50⅛ in.	63 in.
Weight of main rod	417 lbs.	850 lbs.
Weight of front rod	208 lbs.	181 lbs.
Weight of back rod	92 lbs.	310 lbs.
Weight of intermediate rod	—	391 lbs.
Weight of high pressure piston and rod	297 lbs.	664 lbs.
Weight of low pressure piston and rod	459 lbs.	—
Weight of cross heads	228 lbs.	375 lbs.
Weight of crank pin (one side)	184 lbs.	400 lbs.
Average wheel load	15,175 lbs.	26,088 lbs.

The general dimensions, weights and ratios of these locomotives are as follows:

GENERAL DATA.

Gauge	4 ft. 8.9 in.
Service	Freight
Fuel	Bit. coal
Tractive effort	42,300 lbs.
Weight in working order	206,000 lbs.
Weight on drivers	182,000 lbs.
Weight on leading truck	24,000 lbs.
Wheel base, driving	9 ft.
Wheel base, total driving	34 ft. 10 in.
Wheel base, total engine	41 ft. 10 in.

RATIOS.

Weight on drivers ÷ tractive effort	4.30
Total weight ÷ tractive effort	4.86
Tractive effort × diam. drivers ÷ heating surface	833.00
Total heating surface ÷ grate area	62.80
Firebox heating surface ÷ total heating surface, per cent	5.22
Weight on drivers ÷ total heating surface	71.50
Total weight ÷ total heating surface	80.80
Volume equiv. simple cylinders, cu. ft	10.60
Total heating surface ÷ vol. cylinders	240.00
Grate area ÷ vol. cylinders	3.82

CYLINDERS.

Kind	Mellin comp.
Diameter and stroke	17½ and 28 x 26 in.

VALVES.

Kind	Pistou
Greatest travel	5" H. P.—5¼" L. P.
Outside lap	1" H. P.—⅞" L. P.
Inside clearance	⅛ in.
Lead in full gear	⅛ in.

WHEELS.

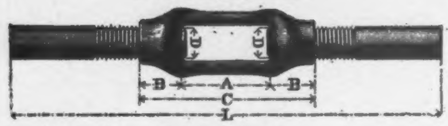
Driving, diameter over tires	50⅛ in.
Driving, thickness of tires	3 1/16 in.
Driving journals, main, diameter and length	7½ x 9 in.
Driving journals, others, diameter and length	7 x 9 in.
Engine truck wheels, diameter	33½ in.
Engine truck journals	6 x 10 in.

BOILER.

Style	Straight
Working pressure	214 lbs.
Outside diameter of first ring	66¾ in.
Firebox, length and width	89⅞, 64⅞ in.
Firebox plates, thickness	14 & 30 mm.
Firebox, water space	4 in.
Tubes, number and outside diameter	269—48¾ mm.
Tubes, length	18 ft.
Heating surface, tubes	2,414 sq. ft.
Heating surface, firebox	133 sq. ft.
Heating surface, total	2,547 sq. ft.
Grate area	40.5 sq. ft.
Smokestack, diameter	17 in.
Smokestack, height above rail	13 ft. 9½ in.

TURNBUCKLES.

Dimensions.



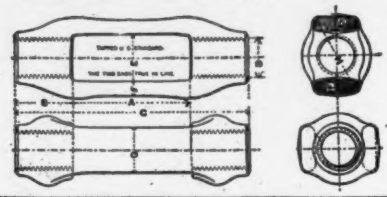
D. Size=Outside Diameter of Screw.
A. Length in Clear between heads=6 in. first length for all sizes.
B. Length of Tapped Heads=1 1/2 D. nearly.
C. Total length of Buckle without Bolt Ends=6 in. + 3 D, nearly.
L. Total Length of Buckle and Stub ends when extended.

SIZE D.	L.	SIZE D.	L.
3/8 Inch	22 Inch	2 Inch	29 Inch
7/16 "	22 "	2 1/8 "	29 "
1/2 "	22 "	2 1/4 "	30 "
9/16 "	22 "	2 3/8 "	31 "
5/8 "	22 "	2 1/2 "	32 "
3/4 "	23 "	2 5/8 "	32 "
7/8 "	24 "	2 3/4 "	33 "
1 "	25 "	2 7/8 "	33 "
1 1/8 "	25 "	3 "	34 "
1 1/4 "	26 "	3 1/4 "	36 "
1 3/8 "	27 "	3 3/8 "	36 "
1 1/2 "	27 "	3 1/2 "	37 "
1 5/8 "	28 "	3 5/8 "	37 "
1 3/4 "	28 "	3 3/4 "	39 "
1 7/8 "	29 "	4 "	41 "

L—A=Length of two stub ends.
The "Size" of the buckle is the outside diameter of the screw, same as bolts, nuts, etc.

Standard Length,	6 inches	between Heads,	(A)	for all Sizes.
Second "	9 "	" "	(A)	"
Third "	12 "	" "	(A)	"
Fourth "	15 "	" "	(A)	"
Fifth "	18 "	" "	(A)	"
Sixth "	24 "	" "	(A)	"
Seventh "	36 "	" "	(A)	"
Eighth "	48 "	" "	(A)	"
Ninth "	72 "	" "	(A)	"

Dimensions in Detail
Pressed Wrought Iron Open Turnbuckles.



Size D Inches	A Inches	B Inches	C Inches	E Inches	F Inches	G Inches	H Inches
3/8	6	9/16	7 1/8	9/16	3/16	1/2	1 1/16
7/16	6	21/32	7 5/16	5/8	1/4	5/8	1 3/8
1/2	6	3/4	7 1/2	5/8	1/4	5/8	1 3/8
9/16	6	27/32	7 11/16	11/16	5/16	3/4	1 9/16
5/8	6	15/16	7 7/8	13/16	5/16	3/4	1 9/16
3/4	6	1 1/8	8 1/4	1 1/16	11/32	7/8	2
7/8	6	1 5/16	8 5/8	1 1/4	3/8	7/8	2 1/4
1	6	1 1/2	9	1 5/16	7/16	1	2 7/16
1 1/8	6	1 11/16	9 3/8	1 7/16	1/2	1 1/8	2 9/16
1 1/4	6	1 7/8	9 3/4	1 9/16	1/2	1 1/4	2 3/4
1 3/8	6	2 1/16	10 1/8	1 11/16	9/16	1 3/8	3 1/16
1 1/2	6	2 1/4	10 1/2	1 3/4	5/8	1 1/2	3 3/16
1 5/8	6	2 7/16	10 7/8	2	5/8	1 7/8	3 1/2
1 3/4	6	2 5/8	11 1/4	2 1/8	11/16	2	3 5/8
1 7/8	6	2 13/16	11 5/8	2 5/16	3/4	2 1/8	3 3/4
2	6	3	12	2 3/8	13/16	2 1/4	4 1/8
2 1/8	6	3 3/16	12 3/8	2 1/2	27/32	2 3/8	4 1/4
2 1/4	6	3 3/8	12 3/4	2 11/16	7/8	2 1/2	4 1/2
2 3/8	6	3 9/16	13 1/8	2 3/4	29/32	2 3/4	4 5/8
2 1/2	6	3 3/4	13 1/2	3 1/16	15/16	3	5
2 5/8	6	3 15/16	13 7/8	3 1/8	31/32	3	5 5/16
2 3/4	6	4 1/8	14 1/4	3 1/4	1	3 1/4	5 1/2
2 7/8	6	4 5/16	14 5/8	3 7/16	1 1/32	3 1/2	6 1/16
3	6	4 1/2	15	3 5/8	1 1/32		6 3/8
3 1/4	6	4 7/8	15 3/4				
3 1/2	6	5 1/4	16 1/2				
3 3/4	6	5 5/8	17 1/4				
4	6	6	18				
4 1/4	9	6 3/8	21 3/4				
4 1/2	9	6 3/4	22 1/2				
4 3/4	9	7 1/8	23 1/4				
5	9	7 1/2	24				

Dimensions E F G H depend upon the specifications of the Bars with which the Turnbuckles are to be used and will be supplied when these are known.

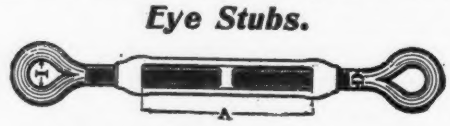
In ordering state size and ultimate tensile strength of Bars.

Weights of Turnbuckles in Pounds.

W. S.—With Stubs. N. S.—Without Stubs.

SIZE	6 inches bet. heads.		9 inches bet. heads.		12 inches bet. heads.	
	W. S.	N. S.	W. S.	N. S.	W. S.	N. S.
3/8	.95	.49	....	....	....	....
7/16	1.35	.75				
1/2	1.57	.75	1.94	1.	2.3	1.35
9/16	2.2	1.19	....	....	....	....
5/8	2.5	1.19	3.15	1.6	3.5	2.1
3/4	3.57	1.62	4.5	2.15	5.	2.66
7/8	4.8	2.05	5.7	2.6	7.75	3.9
1	6.7	2.85	7.6	4.4	10.	4.6
1 1/8	8.35	3.45	9.8	4.66	11.5	6.
1 1/4	10.75	5.15	12.5	6.	14.	7.35
1 3/8	13.	6.	15.25	7.25	17.6	9.5
1 1/2	15.95	7.75	18.9	9.55	21.6	11.5
1 5/8	19.3	8.85	22.5	11.	26.	13.5
1 3/4	21.8	9.95	25.6	12.5	30.5	15.5
1 7/8	26.8	12.5	30.	14.	35.	17.
2	30.8	13.95	35.2	16.	39.	19.
2 1/8	36.7	15.5	42.5	19.	44.5	22.5
2 1/4	43.	18.1	49.6	22.25	53.5	26.
2 3/8	50.	21.4	54.	25.5	66.	29.
2 1/2	58.	25.5	63.5	30.	72.	33.5
2 5/8	64.	27.5	72.5	34.	80.	36.
2 3/4	74.7	32.	80.5	37.75	85.	42.
2 7/8	78.	34.5	88.	41.	99.	47.
3	91.5	41.5	100.	45.5	110.	52.

Turnbuckles with Loop—Welded Eye Stubs.



Suitable sizes for different diameters of wire rope.

Diameter of Rope		D	I
Iron	Steel		
5/16		3/8	3/4
3/8		1/2	1
7/16		5/8	1 1/8
1/2	3/8	3/4	1 1/4
5/8	1/2	7/8	1 3/8
3/4	9/16	1	1 1/2
1	5/8	1 1/8	1 5/8
1 1/8	3/4	1 1/4	1 3/4
1 1/4	7/8	1 3/8	2
1 3/8	1	1 1/2	2
1 1/2	1 1/8	1 5/8	2 1/4
1 5/8	1 1/4	1 3/4	2 1/2
1 3/4	1 3/8	2	3
1 7/8	1 1/2	2 1/4	3 1/4
2	1 5/8	2 1/2	3 1/2
2 1/4	1 3/4	2 3/4	3 3/4
2 3/8	2	3	4
2 1/2	2 1/4	3 1/4	4 1/4

From pages 10, 11, 12 and 13 of the Handbook of the Cleveland City Forge & Iron Company, Cleveland, Ohio.

ELECTRIFICATION OF THE ST. CLAIR TUNNEL.

GRAND TRUNK RAILWAY.

The formal opening of the electric train operation through the St. Clair tunnel took place on November 12, when the St Clair Tunnel Co., a subsidiary of the Grand Trunk Railway, accepted the electric plant and equipment from the contractors, the Westinghouse Electric & Manufacturing Co. The event was celebrated by a large party of engineers and newspaper men who were invited to inspect the work.

The St. Clair Tunnel, which was opened for traffic in 1890, is located under the St. Clair River, and forms a connecting link between the terminal of the western division of the Grand Trunk Railway at Port Huron, Mich., and the terminal of the eastern division at Sarnia, Ontario. The length of the tunnel from portal to portal is 6,032 feet, the approaches being slightly over 2,500 feet, and nearly 3,300 feet in length, making the total distance between the American and the Canadian summits 12,000 feet, or about 2¼ miles. The grade on the tunnel approaches and the inclined sections of the tunnel is 2 per cent., while the flat middle section, about 1,700 feet in length, has a grade of 0.1 per cent. downward toward the east, just enough to provide for the proper drainage of any seepage water.

A single track extends through the tunnel, while a double track is laid in both of the approaches. The necessary tracks for handling the freight and passenger traffic are provided in the yards at Port Huron and Sarnia. The map and profile of the zone operated by the St. Clair Tunnel Company is shown above.

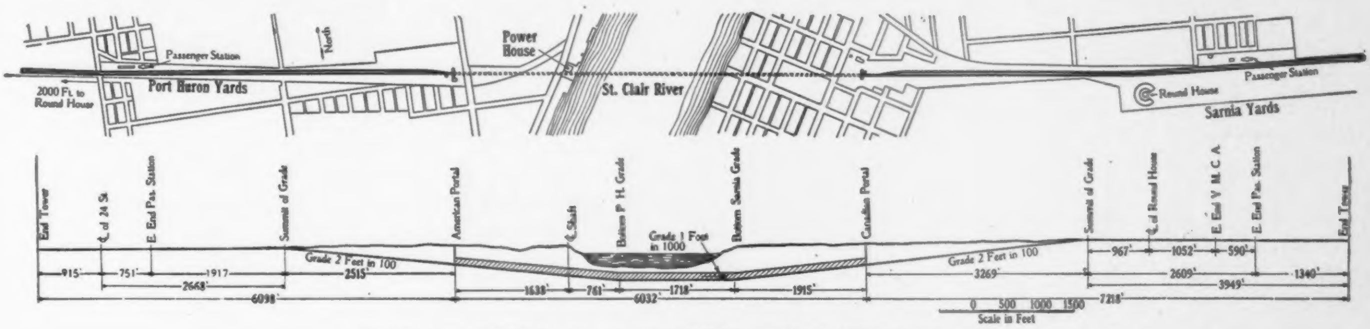
The disposal of the rainfall on the tunnel approaches requires particular attention. The areas of the Port Huron and Sarnia approaches are approximately 11 and 13 acres respectively. Water precipitated on these areas during a rainfall is discharged into waste ditches on the bank above by means of pumps of large capacity. Retaining levees have been constructed, so arranged as to impound a large proportion of the water falling on the approaches. By this method the pumps have to handle only the water falling on the central portion of the approach during the rainstorm. Later the impounded water is discharged into the pump sump by valves provided for the purpose.

As is evident, this pumping service is of great importance in the operation of the tunnel, as, should the tunnel become flooded with water, entire interruption of the traffic would ensue. For the operation of the steam drainage pumps, boiler plants were provided at each portal, and attendants are constantly on duty, it being necessary to keep up steam during a large part of the year in order to take care at a moment's notice of any rainfall that might occur.

Four steam locomotives of special design have been in commission since the construction of the tunnel. They were designed to provide the necessary high tractive effort required to operate the trains over the grades in the tunnel and on the approaches, and arranged to burn anthracite coal, in order to minimize the inconvenience due to excessive smoke in the tunnel. These locomotives have given good account of themselves, and have handled the traffic in a satisfactory way throughout their service. Their maximum tractive effort limited the weight of the trains handled to about 760 tons, and even with this load the speed up the 2 per cent. grade was often very slow. With the constantly increasing traffic, at times the capacity of the tunnel with its steam equipment was taxed in handling the tonnage delivered to the Tunnel Company, and it was thought desirable to make such changes in the operation of the tunnel as would increase its possible capacity for handling traffic, and at the same time obviate the danger and inconvenience due to the presence of the locomotive gases in the tunnel.

The advantage of the use of electric locomotives, on account of the freedom from smoke and the attendant discomfort, together with the possible greater economy in operation, led finally to the decision to provide an electrical equipment to handle the tunnel service, this equipment to provide for the operation of the trains through the tunnel by means of electric locomotives; the handling of the drainage and seepage water by means of electric pumps; the lighting of the passenger stations, the tunnel and the roundhouses by electricity, as well as furnishing a certain amount of power to the roundhouses; also, provision was made for a limited amount of outside lighting in the form of arc lamps. The different electrical systems available for such service were considered, and estimates as to the relative cost and efficiency of the various systems were prepared and submitted. Decision was finally made in favor of alternating current, using a 3-phase system for the distribution of power required for pumping and for shop motors with single phase distribution for locomotives and lighting.

In order to increase the capacity of the tunnel, it was desirable to provide for the maximum practicable tractive effort in the new locomotives. The capacity limit was determined by the maximum pull to which it was deemed wise to subject the drawbars on the mixed rolling stock that must be handled, without danger of breaking trains in two. With this in view the locomotives were specified to be of sufficient capacity to develop a drawbar pull of 50,000 pounds, when operating at a speed of 10 miles per hour. It was estimated that such a locomotive would be able to make the complete trip through the tunnel from terminal to terminal with a 1,000-ton train in fifteen minutes, or four 1,000-ton trains per hour, which would provide a capacity for traffic about three times larger than the actual maximum demands up to the present time.



PLAN AND PROFILE, ST. CLAIR TUNNEL—GRAND TRUNK RAILWAY.

It was estimated that the pumping service, for which adequate provision must be made, would require the installation at the Sarnia portal of two pumps each of capacity of 5,500 gallons per minute, and at the Port Huron portal the installation of two pumps each with a capacity of 4,000 gallons per minute. To provide absolute continuity of service, duplicate pumping equipments were provided in each portal, as well as duplicate feeder lines leading from the power plant to the pump houses.

The lighting service to be provided for is of minor importance in so far as the amount of power required at both Sarnia and Port Huron is concerned, this being somewhat less than 100 kw. The power requirement for motors in the roundhouses at Port Huron and Sarnia is about 100 kw. for both shops.

To furnish electrical energy for this service, provision must be made in the power plant for supplying single phase current for the electrical locomotives, 3-phase current for the pumping service, and 3-phase and single phase current both for the power and lighting service at various points throughout Port Huron and

Sarnia, as well as for a small amount of arc lighting.

Power Station.—The power station is situated on the Port Huron bank of the river, at a point almost directly over the tunnel. The building construction is of concrete to the dynamo room floor. The walls above this point are continued with paving brick and are corniced and coped with concrete. The roof is of cinder concrete. The dynamo room is lofty and well lighted. The walls are lined with enamel brick to the height of the switchboard, the remaining portion being lined with sand lime brick. The basement has plenty of head room and contains the condenser pump groups and stoker fan groups. The dynamo room floor is so recessed that the auxiliary apparatus in the basement is in view from the dynamo room floor. The boiler room floor is on the same level as the dynamo room basement floor. A striking feature of the boiler room is the reinforced concrete coal bunker. This extends the entire length of the boiler room, and has a capacity of 500 tons.

The power station equipment is in duplicate. There are two 1,250 kw., three-phase, 25-cycle, 3,300 volt turbo-generators, either of which is capable of handling the maximum demand upon the station. Each turbine has its independent barometric condenser. There are two steam driven exciters and a motor driven exciter group. The momentary peak loads have reached 2,400 kw., single-phase, and a Tirrill regulator has been provided to keep the voltage of the locomotive phase uniform over the entire range of load. There is in addition to the locomotive load a small three-phase load consisting of power house motors, drainage pump motors and roundhouse motors. The incandescent lighting is connected to same phase as the locomotives.

Since there is but a single track in the tunnel, there can be only one train on the grade at a time, consequently the load is an extremely variable one. The plant has been designed to meet this condition. The turbines have a large overload capacity and the boilers have extra large steam drum capacity. The four boilers have a nominal rating of 400 h.p. each, and each boiler has three steam drums. Ordinarily there are three boilers in use, although two are sufficient to care for the average load. Steam is kept up in the third boiler in order to avoid the delay which would occur in getting it into commission in case of an accident to an active boiler. When there is a drop in boiler pressure due to a heavy overload the speed of the forced draft fan engine is automatically increased, and at the same time the fuel supply to the underfeed stokers is automatically increased by the speeding up of the stoker feeding mechanism. The nominal boiler pressure is 200 pounds and the nominal turbine pressure is 175 pounds, consequently some drop in steam pressure is allowable, but the automatic action of the stokers is such as to keep the drop from becoming excessive. The separately fired superheater is of a type that has considerable heat storage capacity. The temperature is controlled by the means of dampers, which are automatically operated by a water piston whose valves are operated by an electro-magnet primarily controlled by a thermo-couple in the steam line. The automatic control is arranged for a low uniform superheat in order that there may be no wide variation of temperature in the exhaust portion of the turbine when a heavy change in load occurs. High pressure superheated steam is used in the turbine alone. An auxiliary steam line, tapped off between the boilers and the superheater and equipped with reducing valves, delivers low pressure saturated steam to the auxiliaries. The auxiliaries exhaust into a feed water heater. The boiler feed pumps draw their water supply from the condenser discharge.

The station was put in commission November, 1907, at which time it was thoroughly tested out with an artificial load that corresponded to actual service conditions. Later it was subjected to an official test and was found to more than meet the contract guarantees. The station has been operated from the start by the Tunnel Company's employees, although during the preliminary operating period the operation was nominally in the hands of the contractors. The station, while it is a simple one, contains refinements that good engineering demands. The load factor is necessarily bad, which fact, of course, is not conducive to economy. But the station has been designed to meet the tunnel conditions, and its economy is all that can be expected with a single track heavy grade freight load.

Distributing System.—Just outside the power station there is a vertical shaft which extends to the tunnel. A reinforced concrete duct chimney has been built in this shaft as a continuation of the power station duct lines. All the feeders pass from this chimney through holes in the tunnel shell into the tunnel. The locomotive feeders tap the trolley and rail at this point, which is the only distributing point for the entire trolley system. There are section breaks and switches for isolating particular sections of the trolley wires in case of accidents, but normally the trolley wires are continuous from the limits of the Port Huron yards through the tunnel to the limits of the Sarnia yards, a distance of 3.7 miles.

In addition to the locomotive feeders there are two feeders for the tunnel lights, two feeders for the Port Huron portal pump groups, two for the Sarnia portal pump groups, a three-phase power feeder and an arc light feeder for the Port Huron yards and similar feeders for the Sarnia yards. These cables are carried through the tunnel in ducts which are supported by reinforced concrete beams and secured to the lining of the tunnel shell. There are two of these beams, one on each side of the tunnel. The ducts are covered with a three-inch layer of concrete. The feeders are paper insulated lead covered cables and terminate at the pump house switchboards, from which point the arc circuit and the three-phase power circuit continue as bare overhead wires.

In the yards a single catenary trolley construction is used. The spacing of the supporting bridges is 250 feet. There are no obstructions in the nature of intermediate supports, consequently where a number of parallel tracks are electrified the spans are long, as at the Port Huron passenger station where one of the spans is a little in excess of one hundred and forty-three feet. The bridges are tied together with guy cables. This enables a lighter construction to be used than if each bridge were sufficiently rigid, without the use of guy cables, to withstand the unbalanced strain resulting from the breaking of several messenger cables and trolley wires. The trolley wires are twenty-two feet above the tracks except in the tunnel and a short distance outside each portal.

In the tunnel a modification of the catenary construction is used. There are two parallel messenger cables and two parallel trolley wires. The messenger cables are supported on barrel type insulators spaced at intervals of twelve feet. These messengers carry the special double trolley hangers which are also spaced at intervals of twelve feet, but located three feet from the middle of the messenger span. This arrangement gives the required flexibility and at the same time avoids a dangerous vertical displacement of the messenger cables when the pantagraph bow passes under the trolley hanger. The clearance between the messenger cables and the tunnel shell is three inches. The trolley wires are six inches below the messengers which gives a minimum clearance of fifteen feet five inches between the trolley wires and the rail.

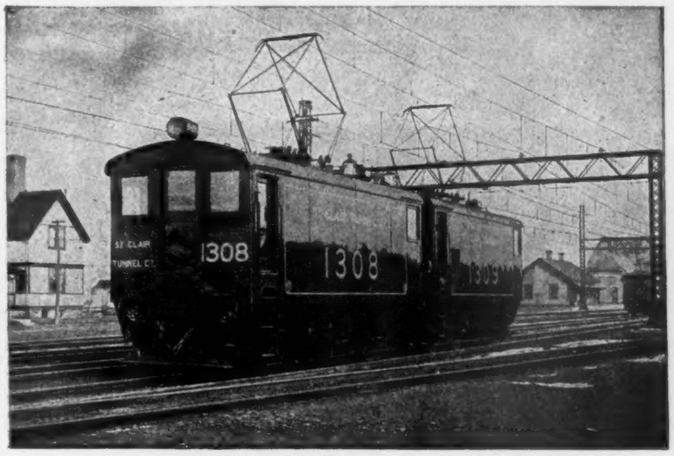
The tunnel is damp throughout a considerable portion of its length, consequently there was some doubt as to the advisability of attempting to carry 3,300 volt bare wires within three inches of the cast iron shell. Any fears that may have been entertained have proved to be groundless, for but two insulators have failed since the electric locomotives were put in operation. The weak insulators were eliminated before the service was inaugurated by the use of breakdown tests which were continued until the overhead construction withstood a pressure of 4,500 volts.

The tunnel is well lighted by 480 incandescent lights. These lamps are placed in two rows, one row on either side of the tunnel. They are spaced every twenty-five feet, but as they are staggered there is a lamp for every twelve and a half feet of tunnel length. Since the voltage of the lighting circuit is 440 volts, the lamps are grouped four in series.

On account of the frequency, 25 cycles, it was impossible to use alternating-current arc lights, consequently a mercury converter was installed. There are two loops from the power sta-

tion, one of which is for the Port Huron lights and the other for the Sarnia lights.

DISPATCHING.—The tunnel division is protected by a block signal system which extends from summit to summit. The dispatcher's cabin is located at the Sarnia summit and the other signal cabin at the Port Huron summit. Telegraph orders are used. In addition to the written order the conductor receives a staff when the train enters the block. The switches and signals are locked until this staff is placed in the instrument at the other end of the block. The protection is so complete that not a single accident chargeable to dispatching has occurred during the eighteen years of tunnel service. There is a yard telephone system and in addition a special telephone line connecting the power station, the two signal cabins at the two portals, the middle of the



SINGLE PHASE ELECTRICAL LOCOMOTIVE—ST. CLAIR TUNNEL CO.

tunnel and the roundhouse. The dispatcher is the master of the situation. He not only controls the train movements but the motive power as well. Any failure of power is immediately reported to him. In case it is trouble with a locomotive he has the engine replaced. In case it is trouble with the distributing system he orders the power cut off, then communicates with the electrical superintendent who takes charge of the repairs. As soon as the repairs have been effected the dispatcher is advised and orders the power turned on again. He is also advised as to any power station trouble that will interfere with train movements. There is no division of responsibility. This arrangement is the logical one, since it is the dispatcher's business to get the trains through the tunnel. He must accordingly be supplied with the necessary motive power and be kept advised as to its availability. Likewise in case of trouble on the line he must protect the repairmen by keeping the power off until the proper authority has advised him that power can be turned on again.

LOCOMOTIVES.—Three locomotives have been provided, each consisting of two half-units, each half-unit being mounted on three axles driven through gearing by three single phase motors with a nominal rating of 250 h.p. each. Since the motors have a very liberal overload capacity, it is possible to develop 2,000 h.p. in one locomotive. The half-units are duplicates in every respect, and as the multiple unit system of control is used, they can be operated when coupled together with the same facility as when separate.

As previously stated, the locomotives are designed to develop a drawbar pull of 50,000 pounds at the comparatively low speed of ten miles per hour. The locomotives are powerful enough to start a 1,000-ton train on a 2 per cent. grade in case this should be necessary. At a test made on a half-unit, using a dynamometer car, it was found that a single half-unit developed 43,000 pounds drawbar pull before slipping the wheels. This was done on a comparatively dry rail with a liberal use of sand. On this basis it would be possible to develop about 86,000 pounds drawbar pull with a complete locomotive. The maximum speed of the locomotives is 35 miles per hour. It is not, however, the intention of the Tunnel Company to operate the locomotives at a speed in excess of 30 miles per hour, at which the locomotive will give a tractive effort of 6,000 lbs. Speed indicators are provided, which indicate on a large dial located in the locomotive cab near the engine driver's seat the speed at which the locomotive is running, and at the same time record the speed throughout the length of the run.

The frames of the locomotives are of the rigid outside bar type, and consist essentially of two cast steel side frames joined at the ends by heavy cast steel bumper girders and reinforced by cross braces at two intermediate points. The main journal boxes are carried in the side frames in pedestals fitted with shoes and wedges.

The three pairs of driving wheels, 62 inches in diameter, are built up with cast steel centers and steel tires secured in place by double "Mansel" retaining rings. The total weight of the locomotive rests on the drivers.

The cab is a superstructure of sheet steel with a Z-bar frame built up on an angle iron base frame. The auxiliary apparatus is arranged on each side of the cab leaving a wide aisle down the center. Trap doors are provided in the floor to render access to the motors easy. The locomotives are double ended, that is, a master controller and set of brake valves are mounted at each end of the cab so that the locomotive can be operated from either end. The apparatus in the cab is so laid out that any part can be readily inspected and replaced if necessary.

MOTOR EQUIPMENT.—The motors are of the ten-pole compensated type and are designed to operate at a normal voltage of 235 volts at a frequency of 25 cycles. They are connected in multiple and are so arranged that any one or two motors can be disconnected in case of trouble. The cut-out switches are designated by numbers and are mounted on the end of the reverse group. The motors are provided with air inlets, and ducts of ample size lead to these inlets from a blower so that forced ventilation can be effectively used. The blower also supplies air to ventilate the main auto-transformer. The continuous capacity of the motors under forced ventilation is 750 amperes at 235 volts. This rating would permit two half-units to pull a 2,500-ton train at a constant speed of 15½ m.p.h. for any desired length of time on a straight level track.

CONTROL AND AUXILIARIES.—The essential parts of the control system in each half-unit are: one 3,300 volt auto-transformer, three preventive coils, a train line relay, three switch groups, two master controllers, two small storage batteries and a small motor-generator set.

The main auto-transformer is located on the right side of the cab in the center. It is connected to the trolley by a high-tension cable through an oil circuit breaker provided with a no-voltage release protective relay. In case the locomotive should leave the rails and the frame thus become insulated from ground, this relay would cause the circuit breaker to open and remain open until the ground connection to the locomotive frame becomes re-established.

The preventive coils, three in number, are located directly over the blower in the No. 1 end of the cab and provide a means of stepping from one transformer tap to another without producing a short-circuit in the transformer or an open circuit to the motors. At the same time they serve to distribute the motor current among the four switches in the transformer switch groups.

The train line relay is located between the transformer switch groups, its purpose being to enable a number of the wires leading from the master controllers to be used twice, thus cutting down the number of control wires required between half-units when operating in pairs, and at the same time shortening the length of the controller drum.

There are three switch groups, two being transformer groups and the third the reverser group. The transformer groups are located above the transformer with the train line relay between them. Each group consists of ten electro-pneumatically operated switches. The function of these groups is to connect the motors to the various taps on the auto-transformer to give the requisite speed regulation. As these switch groups are very close to the

transformer, the leads between the two pieces of apparatus are very short. The third switch group is located on the left side of the locomotive and consists of 12 electro-pneumatically operated switches. The switches in this group control the direction in which the locomotive is run. There are four of these switches for each motor, two for operation in the forward direction and two for reversing.

A master controller is located at each end of each half-unit on the right side, so placed that the engineer can have a clear view ahead from his seat and, at the same time, can easily operate the controller and brake valve handles. Each master controller has two interlocking handles; one is the operating handle and the other the reversing handle. The master controller operates the various switches in the switch group by current from a 20-volt storage battery circuit and has 17 running notches and three switching notches. In the operation of the locomotives the controller can be left on any of the running notches, as there is no resistance to overheat and burn out. This gives the alternating-current locomotive a very distinct advantage over the direct-current type where only two or three running notches are available. The switching notches are used only for running the locomotive without load at low speed, as when passing over switches and frogs in the yards, and are passed over when handling a load. The engineer is guided in the operation of the controller by an ammeter mounted directly before him in the cab. In case the engineer operates his controller too fast, the circuit breaker will open and cannot be reset until he has thrown the controller handle to the "off" position. The circuit breakers on the locomotives are normally set to open when a current exceeding 4,500 amperes is taken by the motors. Across the top of the controller are located a number of push buttons which, when pressed, operate respectively the pneumatic bell ringer, pneumatic sanders, circuit breaker reset, and pantagraph trolley. Foot pedals are placed within convenient reach of the engineer's foot which also serve to operate the bell and sanders. The general principle of the operation of the control system is as follows: Air cylinders are used to operate the various switches and low voltage magnet valves to control the supply of air to the various switches. Two or more locomotives may be operated as one unit from any controller by inserting the proper "jumpers" between locomotives.

The ten cell (20 volts) storage batteries provided to operate the control magnets are in duplicate, one being in use while the other is being charged. The charging is done by means of the small 100 watt motor-generator set previously mentioned.

The air compressor is located beside the main reservoir on the left side. The maximum pressure used is 100 lbs., gauge pressure. A reducing valve lowers the pressure to 80 lbs. for use in the control system. The blower is located on the left side under the preventive coils. Both the compressor and blower motors are operated from low voltage taps on the main auto-transformer. In addition to the ammeters at each end of the locomotive a "motor" voltmeter, a "line" integrating wattmeter, and a "motor" indicating wattmeter are provided and are located on the left side of the locomotive above the reversing switch group.

The current is collected from the trolley wires by means of a sliding bow pantograph trolley. In so far as the trolley wire extends throughout the length of the tunnel, no additional provision has to be made for the collection of current while the locomotive is passing through the tunnel. Electric headlights are provided, as well as lights for the illumination of the interior of the cab and the dials of the indicating instruments. The heating of the cabs is provided for by means of standard electric heaters. Heat is also available for drying the sand stored in sand boxes. In general, the M. C. B. standards have been conformed with in so far as couplers, wheel treads, etc., are concerned. The general dimensions of the half-units are as follows:

Length over all	23 ft. 6 in.
Height from top of rail to top of roof	13 ft.
Height from top of rail to top of pantograph bow when lowered	14 ft. 11 in.
Width of cab over all	9 ft. 8 in.
Total weight of locomotive half-unit, fully equipped	67½ tons
(This weight is practically evenly divided over three drivers.)	
Weight of complete locomotive unit	135 tons
Length of rigid wheel base	16 ft.
Diameter of driving wheels	62 in.
Normal speed of train, ascending 2 per cent. grade (miles per hour)	10
Normal speed on level tracks (miles per hour)	25 to 30

In service it has been found that the locomotives will very readily handle a 1,000-ton train at from 11 to 12, and possibly 13 to 14 miles per hour on a 2 per cent. grade, thus demonstrating their ability to more than fulfil the specified performance.

Mr. Bion J. Arnold, who prepared the original specifications for this work, has acted as consulting engineer for the railway company, and as such has had a general supervision of the installation. The contractors were the Westinghouse Electric and Manufacturing Co., who were directly responsible for the installation and successful operation of the entire equipment.

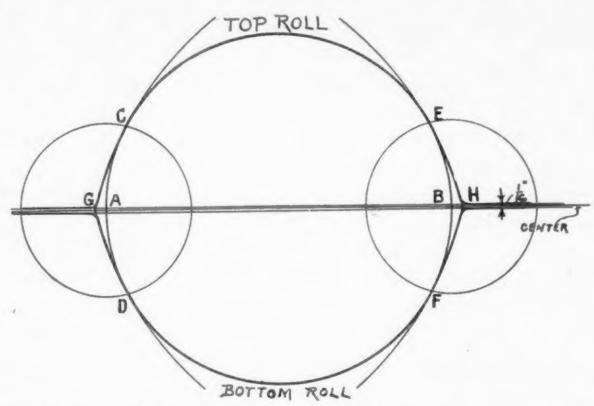
The information in this article has been largely drawn from a pamphlet prepared by F. A. Sager and issued by the general passenger department of the Grand Trunk Railway, and articles by H. L. Kirker, L. M. Aspinwall and C. Bright in *The Electric Journal.*

A SMALL "HAND-AROUND" MILL, ADAPTED TO RAILROAD WORK.

By J. S. Sheafe.*

Railroads are becoming more and more interested in reclaiming what is ordinarily regarded as scrap material. Two or three of the larger roads have obtained splendid results by installing a small rolling mill and reducing scrap rods to a smaller diameter. The illustration shows a "two high" or two roll mill which has been in use in the Burnside shops of the Illinois Central Railroad for the past fourteen months and is similar to one which has been used in the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Railway shops for a long time.

Such a mill may be purchased from any of the rolling mill equipment companies at a cost of one thousand dollars or less, but should preferably be three-high so that the material may be



ILLUSTRATING THE METHOD OF LAYING OUT TEMPLATES FOR THE ROLLS.

A B is the diameter of the pass.
One-quarter of A B is taken as a radius and with centers at A and B the circle is cut at C, D, E and F.
With F and D as centers and radii equal to F C and D E the arcs C G and E H are drawn.
The corners at G and H are then chamfered slightly.
G C E H F D is then the contour of the pass.

passed back through the rolls instead of handing it back to the head roller, as is necessary with the two-roll mill.

Scrap iron from 1 to 2¼ ins. in diameter is cut to lengths convenient for handling, heated in a furnace to a soft heat, and passed to the head roller who starts it through the rolls. A man behind the rolls catches the iron and passes it back over the top to the roller, who continues to work the iron down to the size desired. (The three high roll would permit the "catcher" to send it back to the roller through the next pass.) The iron, when down to size, should be up-ended for the finish, after which it is

* Mechanical Inspector, Illinois Central Railroad.

TWO-HIGH ROLLING MILL—ILLINOIS CENTRAL RAILROAD.

passed to the straightening table, straightened while hot, and placed upon a "hot bed," or any level surface, to cool. The pieces when finished vary from 5 to 8 feet in length, according to the size of the billet; the waste from short ends, in cutting to length, is surprisingly low.

The passes are from 2⅛ to ¾ ins. round and are reduced by ⅛ in. to the ⅞ in. pass, after which the reduction is 1/16 in., it having been found that ⅛ in. draw is too much for the small sizes. The limit of size is ¾ in., as the labor required to further reduce it overbalances the profit, in addition to the difficulty of holding it up to secure a round cross-section.

The rolls are made of charcoal iron, and may be turned up in any heavy lathe. The "neck," or bearing is turned from a center, after which the rolls are put in bearings and the passes turned while thus supported. The passes are made perfectly round by means of a thimble, which rests against a forked piece, which in turn is held in the tool post.

The round passes are further finished to templates; the accompanying sketch illustrates the manner of making these. The iron, in being reduced, must have some space into which to flow and the object of the form furnished by the template is to provide this space and still preserve the general form for the next smaller pass; 1/32 in. is taken from each roll, thereby allowing them to be separated 1/16 in. when set up. This means that the diameter of each roll is reduced 1/16 in. and this operation should be performed after the passes are in, so that they will not be off-size when the rolls are together. One of the templates should be made for at least each of the finished sizes of iron, *i. e.*, ¾, ⅞, 1, and 1⅛ in.; the other sizes are of less importance, so long as part of the pass is cut away to the general form of the template.

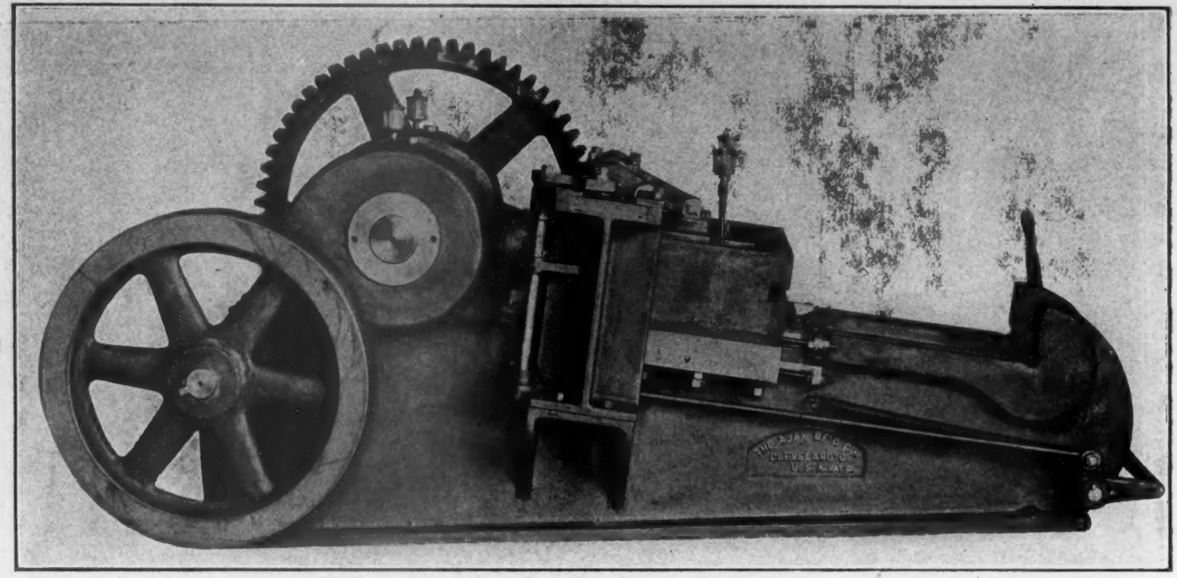
Through the rolls may be seen the guides, one at each pass, whose function it is to pick up the iron as it comes through. The top roll, being ⅛ in. larger in diameter than the bottom one, naturally holds the iron down against the guides.

As high as 6,500 pounds of iron have been sent through these rolls in nine hours at a labor cost of $12.50 and $2.00 for fuel. This, of course, is the high-water mark, but the average daily output, with a good set of men, on a piecework basis, would nearly equal these figures.

REPAIR OF CRACKS AND BLOW HOLES IN CASTINGS.

A large amount of money is spent every year replacing machinery and parts, automobile cylinders, castings, radiators, boilers, fire pots, pipes and many other things which have become useless because of cracks, spongy spots, sand holes or blow holes. There is hardly a factory of any size which does not contribute something to this scrap heap every year because it is not possible to repair such defects in iron and steel.

A new compound which has recently been placed on the market by H. W. Johns-Manville Company, New York, is claimed to make repairs of this kind perfectly. It is called "Leak-No Metallic Compound" and is a chemical composition resembling powdered iron. When mixed with water and applied like putty to defects in iron or steel articles it metalizes and is said to become a permanent part of the article to which it is applied. The manufacturers guarantee it to stop any ordinary leak against any pressure in anything made of iron or steel. It will also stand any heat that iron will stand. If this compound comes up to the claims it certainly will prove to be a great boon to all manufacturers.



AJAX HIGH SPEED STOP MOTION BULLDOZER.

HIGH SPEED, STOP MOTION BULLDOZER.

A new style bending machine, known as a high speed, stop motion bulldozer, and embodying a number of improvements over the old style, slow motion machines, has recently been placed on the market by the Ajax Manufacturing Company of Cleveland. It is specially designed for bending work cold. These machines are being manufactured in six sizes, from No. 1 to No. 6; the general dimensions of the largest and smallest and one of the intermediate sizes are given in the following table:

	No. 1	No. 3	No. 6
Floor space	5′ x 2′ 2″	10′ x 3′ 6″	15′ x 7′ 6″
Face of crosshead	16″ x 4″	28″ x 8″	60″ x 10″
Travel of crosshead	5″ to 8″	5″ to 10″	5″ to 14″
Travel of crosshead, std	5″	8″	10″
Approximate weight of machine	2,200 lbs.	9,500 lbs.	24,000 lbs.

A ⅝ x 3 in. arch bar, with a set of 8 in., was recently bent cold in a No. 3 machine; the four bends were easily made in one operation.

The most important features of the new machine are the rapid movement of the crosshead and the control which the operator has over it at all times. The crosshead makes 60 strokes per minute for the No. 1 size and 45 strokes per minute for the No. 6, or largest size. The machine may be thrown into operation by either a foot pedal or a hand lever, which causes the crosshead to make a complete stroke and stop wide open.

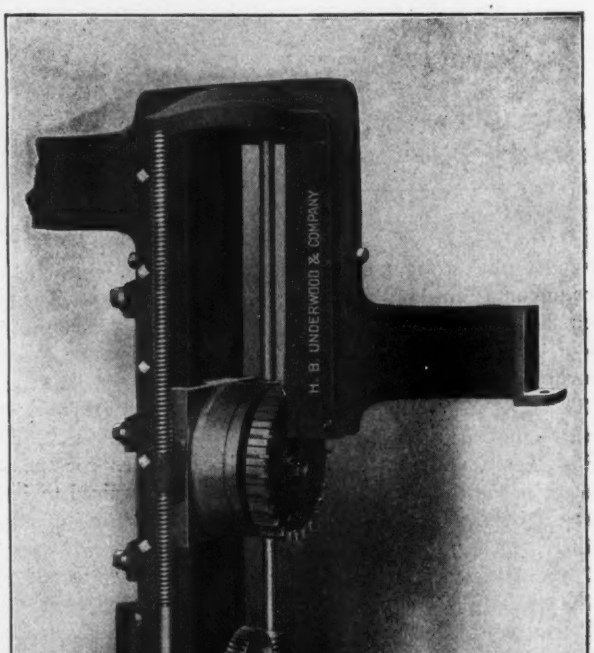
The bed is a steel casting and the crosshead travels at an angle to facilitate placing the stock in the dies. The crosshead has a long bearing surface and is equipped with adjustable gibs to take up wear. The gears are machine cut and the bearings are bushed with bronze.

While the machine is primarily intended for bending purposes, it may also be used as a press or shear. The rapid motion of the crosshead makes it possible to obtain a greater output and where the stock will stand a cold bend a considerable saving may be made in fuel.

Don't Be Afraid to Ask Questions.—If one is not in full possession of knowledge of any particular detail, it is the greatest mistake not to ask questions so as to become so. It is not a lowering of dignity, nor an indication of incompetency to have to ask for such information, in fact, much can often be learned from even the men of the lowest grade by intelligent questioning. Any other principle of conduct usually results in an ostrich act on the part of the one who attempts it, his ignorance being easily apparent.—*W. J. Harahan, before the New York Railroad Club.*

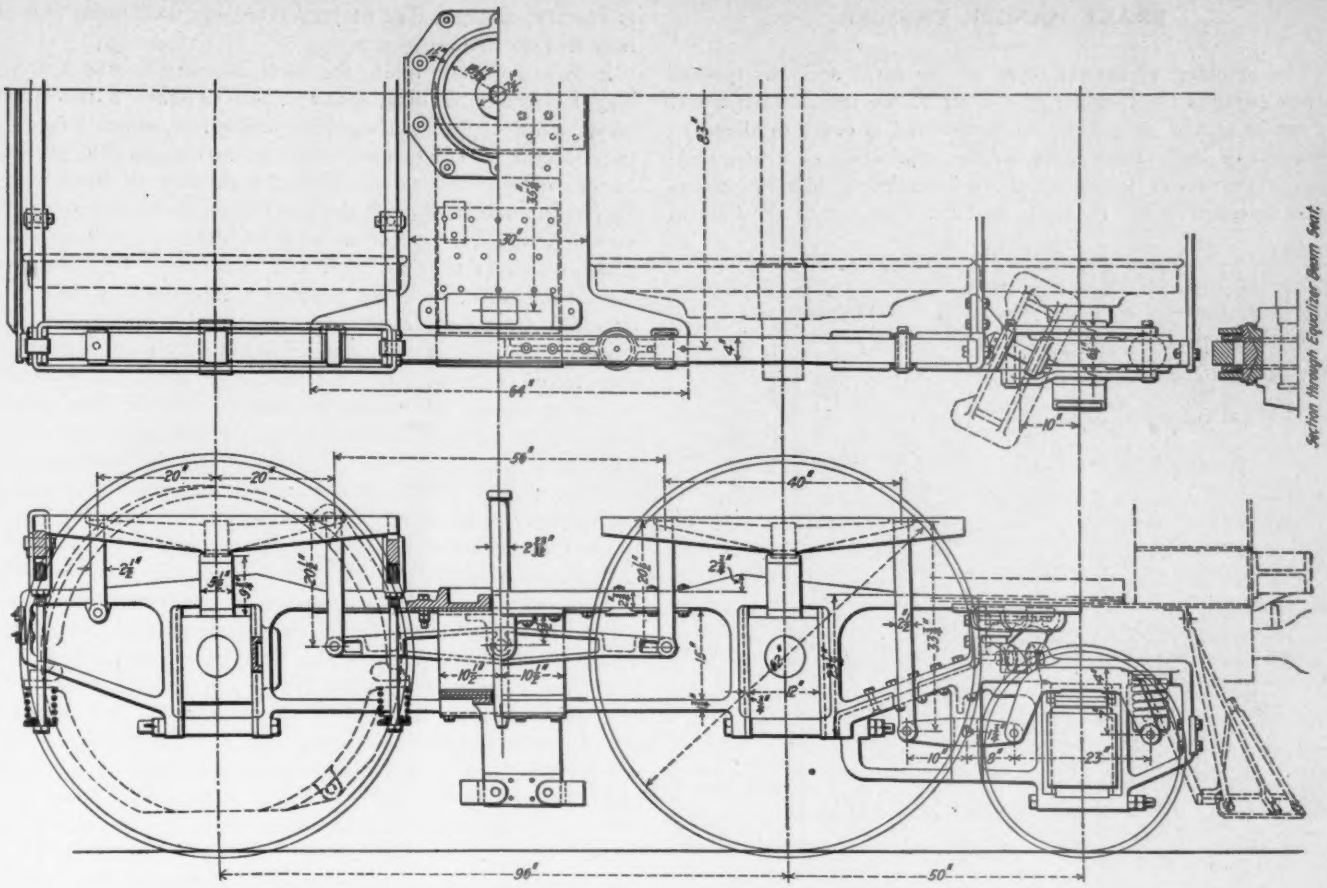
PEDESTAL FACING MACHINE.

The portable machine, shown in the illustration, was originally designed for truing up the pedestals on street and interurban car trucks, but it is also applicable for planing the pedestal jaws of locomotives. It is strong and powerful and has a milling cutter with inserted blades of high-speed steel. This cutter may



be made of any desired diameter and has an adjustment of 1½ in. to allow for different widths between the jaws and for different depths of cut. The cutter is driven from the driving shaft through a worm and worm wheel geared 42 to 1, thus furnishing a powerful and smooth motion to the cutter. A wide range of feeds is provided to suit the various conditions.

The bed of the machine, which carries the sliding head and milling cutter, is made in the form of a chuck, as shown in



ELECTRIC LOCOMOTIVE TRUCK AS ALTERED TO INCLUDE EXTRA PAIR OF WHEELS—N. Y., N. H. & H. R. R.

the illustration, with slots on both the top and bottom edges, on the back, in which the projections of the clamps, that hold the tool rigidly to the pedestal, fit. Adjusting screws are fitted in the center of these clamps and go through and clamp the whole device to the back of the leg without springing the bed, or the work to be milled. At the top and bottom edges are shown six set screws for holding the machine edgeways and these in conjunction with the clamps hold the machine firmly to the work.

Parallel jaws are not the only ones which this tool will mill, for by placing wedge-shaped pieces in the chuck the machine will mill the side having a taper equally as well. It is thus easy to establish and maintain a standard taper. For very wide jaws a parallel piece is used between the chuck and the pedestal to which it is clamped.

The standard cutter is 8¾ in. in diameter and is capable of taking a deep cut. It is adjusted by a socket wrench which fits into and operates a cross-feed screw in the center of the cutter, moving it in or out and still retaining a long bearing for the shaft and driving device. The head has 20 in. travel.

The machine is ordinarily belt driven, but the drive shaft end can be fitted to use an air drill or any portable power. Various sizes are built to meet requirements; the machine is manufactured by H. B. Underwood & Co., of Philadelphia, Pa.

CASCADE TUNNEL ELECTRIFICATION.—Announcement is made that electrically propelled passenger trains will be running through the Cascade tunnel of the Great Northern Railway in Washington before January 1. Turbines and transformers to develop 12,000 horse power are being erected in the power house at Leavenworth and the wood stave pipe line which is to carry a considerable portion of the Wenatchee River to the turbines is ready for service. This pipe line is 10,950 feet in length and eight feet six inches in diameter, inside measurement. It is the largest job of its kind ever undertaken in the Northwest. Eight electric locomotives, which are illustrated elsewhere in this issue, will be used for pulling trains through the tunnel.

APPLICATION OF EXTRA TRUCK WHEELS TO ELECTRIC LOCOMOTIVE.

The New York, New Haven & Hartford Railroad is operating all of its trains between Stamford, Conn., and the Grand Central Station, New York, by electric locomotives of the single phase type, taking current from an overhead trolley system. These locomotives were fully illustrated and described on page 396 of the October, 1907, issue of this journal.

After the locomotives had been in service a short time it was found that the weight on driving wheels was somewhat excessive and that when operating on a tangent the nosing effect of the large four wheel trucks was very annoying. Both of these difficulties have now been corrected by the application of an extra truck wheel on the outside end of each of the driving trucks, the arrangement of which is shown in the accompanying illustration.

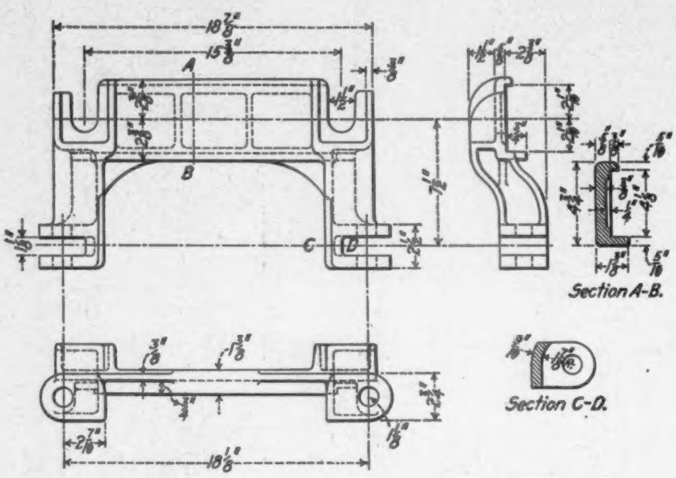
This application consists simply of a supplementary frame, which is bolted to and forms part of the main frames of the truck and includes a radial side bearing of special construction. This is of the rocking instead of sliding type and hence offers minimum resistance to the turning motion around the center pin, and is at the same time able to carry considerable weight. The extra truck wheels are about 33 in. in diameter, and on account of the small space available, are set very close to the driving wheel. The equalizer system of the main truck is continued to permit the extra truck assuming its share of the weight.

It is understood that this application has completely cured the trouble, and that it will be applied to all the present and future locomotives of this type on this road.

FOREST PRESERVATION IN JAPAN.—About 60 per cent. of the total area of Japan is occupied by carefully preserved forests. For many centuries the governing authorities of the empire have left nothing undone to conserve the forestry areas. At present the forests that are immediately under government supervision aggregate 58,000,000 acres.

BRAKE HANGER CARRIER.

The breaking of carrier irons on the usual arch bar type of truck requires the removal of the car to the repair track where it can be jacked up and the truck removed in order to allow the removal of the column bolts for the application of a new casting. The carrier shown in the accompanying illustration has been designed by W. H. Hall, chief car inspector of the Central



Railroad of New Jersey, at Jersey City, N. J., for the purpose of eliminating the delay and labor of renewing broken carriers. It is designed so that it can be fitted without removing the truck from beneath the car and hence without the necessity of putting the car on the repair track. The bolt holes are slotted and a lip is provided for fitting down over the outer side of the arch bar and it can be applied by simply loosening the column bolt nuts and driving the bolt up slightly to permit slipping it into place.

NEW RATCHET JACK.

The rapidity of operation has made the ratchet type of jack a very popular device up to the limit of its capacity, which has

usually been considered 15 tons or under. With this weight in the ordinary designs, the crushing strength of the pawl or teeth is reached, and this type of jack is usually used under this load only in case of necessity.

Recognizing these limits, the Buda Foundry & Mfg. Co., Railway Exchange Building, Chicago, has designed a new ratchet jack, shown in the accompanying illustration, which has a very large factor of safety under 15 tons and is capable of lifting 20 tons with perfect safety. The change made in this design, in addition to the use of the best materials, heavier general construction and very accurate workmanship, consists of special pawls which have triple teeth and thus divide the stress over three teeth in the rack and produce a comparatively light strain on each. Considerable improvement has also been made in the design of the fulcrum pin, which has not only been enlarged and constructed of tempered high carbon steel, but is arranged with a bearing of special design to assist in resisting the shearing stress. The lower part of the lever, through which the pin extends, is arranged to contain a shoulder and the bushing around the pin, which extends through the frame, is continued over the shoulder of the lever and thus supports the fulcrum pin between the lever and the frame.

This jack is single acting, the load being raised on the downward stroke of the lever. An improved arrangement for changing the direction of the lifting bar has been adopted and by a special design the uniform engagement of the triple teeth of the pawls has been assured. The frame and small working parts of the jack are of malleable iron; the lever is of open hearth steel; the rack of high carbon open hearth steel; the pawls are case hardened drop forgings and the fulcrum pin is of high carbon steel tempered and ground.

A test to show the mechanical efficiency of the jack gave a record of 77 per cent. It is said that the ordinary ratchet jacks show about 40 per cent. mechanical efficiency. This jack is given a rated capacity of 20 tons; is 28 in. high in the lowered position; has a 16 in. rise of bar and weighs 135 lbs.

RECORD BREAKING SWITCH-BOARD BUILDING.

The central telephone exchange, at Paris, was completely destroyed by fire on September 21, 1908. Since this completely paralyzed the telephone communication in the city it was imperative that it should be replaced in the shortest possible time. After bids had been presented by all of the larger switchboard manufacturers of the world, the contract was given to the Western Electric Company, who, in spite of the enormous handicap of shipment half way across the United States and across the Atlantic Ocean, were able to promise a delivery of the switchboard, in working order, inside of sixty days, agreeing to a very heavy daily penalty for any excess of that time. This required exceedingly accurate planning and rapid work on the part of this company, as will be appreciated when it is stated that the switchboard is 180 ft. long, requires 90 operators to operate it and will accommodate more than 10,000 subscribers. The back of the board contains about a million soldered connections and about 3,000 miles of wire. In addition to this the company also furnished 135,000 ft., or something more than 25 miles of switchboard cable. The manufacture of the board was principally done at the Hawthorne works of the company near Chicago and the shipment from that point required 234 boxes. About 40,000 feet of lumber were used in packing the complete board and 10,000 sq. ft. of paraffine paper were used in waterproofing the packing cases for the cables.

Definite information concerning this order was received by the New York office of this company on October 3 and the completed switchboard was shipped from Chicago on October 26. This shipment was greatly facilitated by the co-operation of the Grand Trunk and the Delaware, Lackawanna & Western Railways, who delivered the six cars at Hoboken but two days after they were loaded at Hawthorne. The shipment then left New York on board a French line steamship on October 29, which was but a few days more than a month after the fire occurred. It reached Paris on time and was installed well within the contract requirement.

PERSONALS.

P. J. Conrath has been appointed master mechanic of the Missouri Pacific Ry. at De Soto, Mo.

George J. Duffy has been appointed assistant master mechanic of the Lake Erie & Western Ry. at Lima, Ohio.

D. D. Robertson has been appointed master mechanic of the Wyoming division of the Lehigh Valley R. R., succeeding A. M. Gill.

A. J. Wade has been appointed master mechanic of the Louisiana & Arkansas Ry. at Stamp, Ark., succeeding F. A. Symonds, resigned.

G. W. Foster has been appointed general foreman of shops of the Lake Erie, Alliance & Wheeling Ry. at Alliance, Ohio, succeeding W. S. Jackson, resigned.

M. M. Myers, master mechanic of the Missouri Pacific Ry. at De Soto, Mo., has been transferred to Osawatomie, Kan., succeeding Mr. Tutt.

A. M. Gill, master mechanic of the Wyoming division of the Lehigh Valley R. R., has been promoted to general inspector of motive power and rolling stock.

D. E. Meyers has been appointed foreman of the motive power and car departments of the Louisiana & Arkansas Ry., with office at Minden, La., succeeding J. B. Baird, resigned.

Samuel Millican, superintendent of motive power for the Houston & Texas Central Ry. and the Houston East & West Texas Ry., died at Dallas, Tex., on October 22, from a stroke of paralysis.

F. K. Tutt, master mechanic of the Missouri Pacific and the St. Louis, Iron Mountain & Southern Rys. at Osawatomie, Kan., has been appointed master mechanic at St. Louis, succeeding J. J. Reid, resigned.

J. T. Connor has been appointed acting superintendent of motive power and machinery of the Houston, East & West Texas, Houston & Texas Central and Houston & Shreveport Rys., succeeding S. Millican, deceased.

J. D. Harris, formerly works manager of the Westinghouse Air Brake Company, Wilmerding, Pa., has been appointed superintendent of motive power of the Baltimore & Ohio Railroad, with headquarters at Baltimore, Md.

R. E. Smith, road foreman of engines of the Canadian Pacific Ry. at Medicine Hat, Alb., Can., has been appointed master mechanic of the Second district, with headquarters at Medicine Hat, his former position having been abolished.

Allen Vail, master mechanic, Buffalo shop, of the Pennsylvania R. R., has been retired on a pension and the jurisdiction of J. M. James, master mechanic, Olean shop, has been extended to include the entire Buffalo and Allegheny division. Mr. James will transfer his office to Buffalo.

C. F. Smith has been appointed master mechanic in charge of all steam and electrical equipment of the Tombigbee Valley Ry., with office at Calvert, Ala. Mr. Smith for the last three years has been special representative for the Cataract Refining Co., Buffalo, N. Y.

H. Wade Hibbard, professor of mechanical engineering of railways at Sibley College, Cornell University, has resigned to take effect at the end of the first semester, at which time he will take up the duties as head of the mechanical department of the University of Missouri. Professor Hibbard has been at Cornell since 1898 and organized the railway mechanical engineering department of that university.

Alfred R. Kipp has been appointed superintendent of motive power and cars of the Wisconsin Central Ry., succeeding W. G. Menzel, resigned. Mr. Kipp was formerly master mechanic of the Wisconsin Central Ry. and has also been with The Arnold Co., Chicago.

Edward Elden, formerly master mechanic of the New York Central & Hudson River R. R. and the Lake Shore & Michigan Southern R. R. at Buffalo, N. Y., has accepted a position with the Dodge Manufacturing Co., Mishawaka, Ind., as chief of sales of the railroad department.

THE RAILWAY BUSINESS ASSOCIATION.

This association has taken up the work of urging that everyone interested in the speedy return to activity of transportation interests, and a resumption on the part of the railroads of purchases of material and equipment, will at once address demands upon their legislative representatives in State and National capitols for reasonable enactments and for a favorable attitude toward a fair adjustment of rates. That the campaign is to be an aggressive one is indicated by the selection of G. M. Basford, assistant to the president of the American Locomotive Company, as acting secretary. Mr. Basford will give undivided attention for several months to the effort which the Association is making to show the public that anything hurting railroads also hurts whole communities of people directly, and hosts of others indirectly, and that there is immediate necessity for a change toward moderation and calmness in railroad legislation.

BOOKS.

Mechanical World Electrical Pocket Book for 1909.—Pocket size, 4¼ x 6¼. 208 pages. Published by Emmott & Co., 65 King street, Manchester, England. Price, 15 cents, net.

This is the second issue of the separate Electrical Pocket Book, which was formerly included as part of the Mechanical World Pocket Diary and Year Book. It has been greatly enlarged and improved and now contains a very complete and valuable collection of electrical engineering notes, rules, tables and data.

Application of Highly Superheated Steam to Locomotives. By Robert Garbe. Edited by Leslie S. Robertson. 6 x 9½. 66 pages. Cloth. Illustrated. Published by Norman W. Henley Publishing Co., 132 Nassau street, New York. Price, $2.50.

The excellent series of articles which first appeared in *The Engineer* (London), an extended abstract of which was published in the March and September issues of this journal, have been revised and reprinted in book form. As our readers know, these are the most valuable contributions on this subject which have ever appeared in brief form and are written in an exceptionally clear-cut and convincing manner. Herr Garbe, who is Privy Counsellor of the Prussian State Railways, has probably had greater experience and is more thoroughly familiar, in a practical way, with superheated steam in locomotive practice than any other man on either continent. While this book deals with highly superheated steam the matter of low superheat is thoroughly discussed and the reasons of the author for his stand in using steam at least 180 degs. F. above saturation temperature are fully given. In addition to the theoretical discussion of the subject the book also contains full illustrated descriptions, with a discussion of the merits, of all of the better known superheaters in the world. The details of the locomotive, outside of the superheater, for satisfactorily using steam at this high temperature are discussed and the designs introduced by Herr Garbe are

illustrated. Reports on a number of very complete and practical tests form the concluding chapter of the work. This book cannot be recommended too highly to those motive power men who are anxious to maintain the highest efficiency in their locomotives.

FUTURE SUPPLY OF TIES.—As a part of its plan for the future crosstie supply the Pennsylvania R. R. has set out this year 625,000 young trees, making a total of 2,425,000 trees set out in its campaign of reforestization.

CATALOGS

IN WRITING FOR THESE PLEASE MENTION THIS JOURNAL.

SCIENTIFIC BOOKS.—The Hill Publishing Company, 505 Pearl street, New York, is issuing a general catalog of technical books, which includes a classified list, giving the subject and author, brief comment and price, of the best known technical works.

ROLLER BEARINGS.—The Standard Roller Bearing Company, 50th street and Lancaster avenue, Philadelphia, Pa., is issuing a small leaflet calling attention to the wonderful development of anti-friction bearings during the past few years and the facilities which it maintains for manufacturing them.

TIME TO GET BUSY.—The Cleveland Twist Drill Company is issuing a leaflet calling attention to the fact that business is rapidly increasing and that its plant is now running to full capacity. It advises those who wish to obtain a quick delivery on supplies of small tools to take the matter up right away.

SWITCHBOARD INSTRUMENTS.—Bulletin No. 4627, recently issued by the General Electric Company, Schenectady, N. Y., contains matter descriptive of curve drawing instruments for alternating and direct current circuits. These instruments have recently been improved and are fully described and illustrated in this bulletin, which includes a list of prices.

EXHIBIT OF STEEL TUBES.—The National Tube Company, Pittsburgh, Pa., is issuing a pamphlet which fully illustrates and describes the very complete exhibit made by it at the Pittsburg Sesqui Centennial Exhibition. This exhibit was very attractive and interesting and contained examples of Shelby seamless steel tubing that are distorted to a surprising extent without cracking.

AIR COMPRESSORS.—The Bury Compressor Company, Erie, Pa., is issuing catalog No. 42, which fully illustrates and describes the latest developments of the modern air compressor. Machines for direct steam or electric, as well as belt drives are shown for delivering air at practically any desired pressure. The specifications for each machine include a table giving the size of intake and discharge pipes, horse power required, speed and capacity of the machine, etc.

CROCKER-WHEELER COMPANY.—Among the bulletins recently issued by this company are No. 108, which gives a large amount of general information concerning alternating current, including formulæ for calculating the amperes per phase, size of generator and the importance of the power factor. No. 109 describes small generating sets ranging from 2 to 19 kw, capacity. These are direct connected with a steam engine forming the motive power. No. 106 is on the subject of direct current switchboard panels.

JACKS.—The Buda Foundry & Mfg. Company, Chicago, is issuing catalog No. 123, which contains illustrations and descriptions of a most complete collection of ball-bearing, cone-bearing, geared-ratchet, ratchet and friction jacks. These jacks are shown in all practical sizes for lifting any weight suitable to a portable equipment. One of the ratchet jacks is illustrated elsewhere in this issue. In addition to the regular line there are shown a number of special adaptations for meeting unusual conditions. All of the jacks shown in this catalog have been most carefully designed in the light of many years' practical experience.

MILLING MACHINES, ETC.—Pratt & Whitney Co., Hartford, Conn., is issuing a catalog which illustrates and describes milling machines, die sinkers, and profilers. These machines are all precision tools adapted for high grade work. They have the latest improvements and, with few exceptions, are kept in stock and can be furnished very promptly. The illustrations of the tools, of which there are many, both general and detailed, are on a large scale and show all parts of the machine to advantage. The descriptive matter is very complete and tables of specifications in each case are included. This catalog will form a very valuable addition to the library of any one having work of this character to do. It is standard, 9 x 12, in size.

MACHINE TOOLS.—The 1909 edition of Manning, Maxwell & Moore's machine tool catalog has just been issued. It forms a large volume of 1170 pages, 9½ x 13 in. in size and contains excellent illustrations of 2570 different tools with sufficient specification and description of each to make the general features fully understandable. The grouping has been most carefully looked after, those tools of the same kind and for the same purpose being collected together, making it very convenient for any one to investigate any special line or kind. For instance, the first 93 pages of the book are devoted to strictly railroad tools, and 154 different machine tools are shown, which are not adapted for other than railroad shop use. These include wheel and axle lathes, wheel boring machines, special designs of planers, wheel presses, high duty drills, portable presses, flue welding machines, grinding machines, horizontal boring machines, portable cylinder boring machines and many others. Other sections of the catalog also contain tools which are applicable to railroad shop use but are not specially designed for that purpose. The catalog contains a most complete and valuable index and also a full code for telegraphic communication. This catalog is said to be the only one in existence which gives a thorough presentation of modern machine tools designed for service with high speed steel and with the latest devices in electric drives. All of the tools shown are designed and intended for service under the heaviest modern demands and are strictly up to date in every respect. This catalog has been called an encyclopedia of machine tools and really forms the nearest approach to this definition of any book that is published. The excellence of the illustrations and other typographical work is noticeable and adds its full share to the value of the catalog.

NOTES.

ARCH N. CAMPBELL announces that he has established an office at 90 West street, New York, and will handle general railway supplies of all kinds. Mr. Campbell was formerly with the Columbia Refining Company.

NERNST LAMP COMPANY.—After a comparative test, in practical service, of several different makes and types of lamps the proprietors of one of the largest department stores in Pittsburgh have installed 3-glowers Westinghouse Nernst Lamps.

NATIONAL BOILER WASHING COMPANY.—Mr. White, president of this company, sailed on the steamship *Lusitania* November 25 for England and the Continent, where he will devote his time to the interests of this system of boiler washing.

FORGED STEEL WHEEL COMPANY.—The Pittsburgh Railway Company has placed an order for 6,000 forged steel wheels with the above company. These wheels will be delivered during the coming year. The plant of this company, which is closely identified with the Standard Steel Car Co., is located at Butler, Pa.

PROTECTUS COMPANY.—C. H. Spotts, formerly manager of the paint department, and W. F. Swearer, assistant at the general offices of the Joseph Dixon Crucible Company, are now associated with the Protectus Company, Mr. Spotts as secretary and Mr. Swearer as New York manager. The office of this company is at 30 Church street, New York.

STEEL PASSENGER COACHES ORDERED.—The Pennsylvania Railroad has placed orders for 77 all-steel passenger cars. This is in addition to orders for 200 of these cars which were placed some time ago and of which about 110 are now in service. Of the latter order 31 will be made by the Pressed Steel Car Company, 29 by the American Car & Foundry Company, and 17 by the Standard Steel Car Company.

BETTENDORF AXLE COMPANY.—E. E. Silk, formerly associate editor of this journal, who for the past seven years has been in the railway supply business in New York and Chicago, is now connected with the Bettendorf Axle Company and will have offices at 1170 Old Colony Bldg., Chicago. Mr. Silk has had a very wide and valuable experience in connection with the mechanical department of railroads.

CROCKER-WHEELER COMPANY.—The Estey Organ Co., the largest organ manufacturer in the world, is installing electric drives throughout its works at Brattleboro, Vt. The contract for the electrical section of this work has been given to the Crocker-Wheeler Company and includes an order for fifty-seven induction motors ranging from ½ to 75 h. p. The current will be purchased from outside sources.

AMERICAN BRAKE SHOE & FOUNDRY COMPANY.—Warren L. Boyer, formerly with the Peckham Truck Company, and later on with the New York Car & Truck Company, at Kingston, N. Y., has become associated with the American Brake Shoe & Foundry Company as assistant in the engineering department. His duties will be to look after the standardization of brake heads and brake shoes on the lines of the standards of the American Street & Interurban Railway Association.

NEW CAR BUILDING PLANT.—The contracts have been let for the new car building and repair plant of the International Car Company, Maison Blanche Building, New Orleans, La., and bids are now being received for the machinery to equip it. The plant will be a comparatively large one, including a planing mill 60 x 100 ft., a blacksmith shop 60 x 75 ft., machine shop 60 x 60 ft., power house 60 x 100 ft., two open work shops 80 x 600 ft., and an office building. Mr. A. T. La Baron is vice-president and general manager of this company.